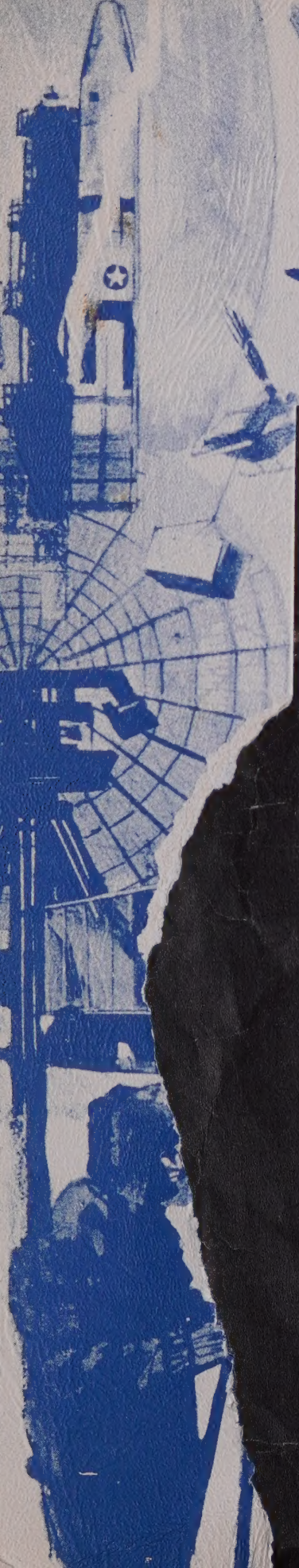


INSTRUCTION MANUAL

NAVELEX 0967-160-9020

MAINTENANCE MANUAL FOR FREQUENCY METER/SIGNAL GENERATOR SYSTEM MODEL FM-2748/ODM-1

MANUAL NO. 500783-238

S/N 1081-04319

Print 12/72 Lib

SINGER
INSTRUMENTATION

The Singer Company, Los Angeles Operation • 3211 South La Cienega Blvd., Los Angeles, Ca. 90016

CONTENTS

Section		Page
I	INTRODUCTION	1-1
	1.1 General	1-1
II	DIFFERENCE DATA	2-1
	2.1 Theory of Operation Differences	2-1
	2.2 Maintenance Differences	2-3
	2.3 Schematic Diagram Differences	2-6
	2.4 Parts List Differences	2-6
III	THEORY OF OPERATION	3-1
	3.1 Introduction	3-1
	3.2 Left-hand Module A1	3-1
	3.3 RF Output Circuit	3-1
	3.4 Broadband Amplifier (A1A4)	3-1
	3.5 Measure Input Circuit	3-1
	3.6 Automatic Level Control	3-3
	3.7 Divider Circuit (A1A2)	3-3
	3.8 Power Supply (A1A3)	3-4
	3.9 Voltage-Controlled Oscillator (VCO) Board A2	3-4
	3.10 1 kHz Frequency Control Circuit A3	3-5
	3.11 10 kHz Frequency Control Circuit A4	3-6
	3.12 100 kHz Frequency Control Circuit A5	3-6
	3.13 1 MHz Frequency Control Circuit A6	3-6
	3.14 10 MHz Frequency Control Circuit A7	3-6
	3.15 Gain Control Amplifier A7	3-7
	3.16 Diode Switch, Mixer, and Low Pass Filter A9	3-7
	3.17 100 MHz Frequency Control Circuit A10	3-8
	3.18 TCXO and Buffer Amplifier A11	3-8
	3.19 Frequency Generator Assembly A12	3-9
	3.20 Frequency Generator Assemblies A13 to A21	3-9

CONTENTS - Continued

Section			Page
IV	FM-10 MAINTENANCE		4-1
	4.1	Introduction	4-1
	4.2	General Maintenance Information	4-2
		4.2.1 Basic Requirement	4-2
		4.2.2 Test Equipment	4-2
	4.3	Power Requirements	4-2
	4.4	Minimum Performance Checkout Procedure	4-2
		4.4.1 Start Procedure	4-2
		4.4.2 Tone Generator Mode	4-2
		4.4.3 Frequency Accuracy	4-5
		4.4.4 Output Level Check	4-5
		4.4.5 Amplitude Modulation Check	4-6
		4.4.6 Frequency Modulation Check	4-6
		4.4.7 Measure Input Sensitivity	4-7
	4.5	Alignment and Adjustment	4-7
		4.5.1 Board A1A3 Adjustment (Figure 4-2)	4-8
		4.5.2 Board A1A2 Adjustments (Figure 4-3)	4-9
		4.5.3 Board A1A4 Checkout (Figure 4-4)	4-12
		4.5.4 Board A2 Adjustment (Figure 4-5)	4-14
		4.5.5 Board A3 Adjustment (Figure 4-6)	4-16
		4.5.6 Board A4 Adjustment (Figure 4-6)	4-18
		4.5.7 Board A5 Adjustment (Figure 4-6)	4-18
		4.5.8 Board A6 Adjustment (Figure 4-7)	4-18
		4.5.9 Board A21 Low Frequency Adjustment (Figure 4-8)	4-20
		4.5.10 Board A20 Low Frequency Adjustment (Figure 4-9)	4-20
		4.5.11 Board A19 Low Frequency Adjustment (Figure 4-9)	4-23
		4.5.12 Board A18 Low Frequency Adjustment (Figure 4-9)	4-23

CONTENTS - Continued

Section			Page
	4.5.13	Board A17 Low Frequency Adjustment (Figure 4-9)	4-23
	4.5.14	Board A16 Low Frequency Adjustment (Figure 4-9)	4-23
	4.5.15	Board A15 Low Frequency Adjustment (Figure 4-10)	4-23
	4.5.16	Board A14 Low Frequency Adjustment (Figure 4-10)	4-23
	4.5.17	Board A13 Low Frequency Adjustment (Figure 4-10)	4-23
	4.5.18	Board A12 Low Frequency Adjustment (Figure 4-10)	4-23
	4.5.19	Board A21 High Frequency Adjustment (Figure 4-8)	4-25
	4.5.20	Board A20 High Frequency Adjustment (Figure 4-9)	4-25
	4.5.21	Board A19 High Frequency Adjustment (Figure 4-9)	4-27
	4.5.22	Board A18 High Frequency Adjustment (Figure 4-9)	4-27
	4.5.23	Board A17 High Frequency Adjustment (Figure 4-9)	4-27
	4.5.24	Board A16 High Frequency Adjustment (Figure 4-9)	4-27
	4.5.25	Board A15 High Frequency Adjustment (Figure 4-10)	4-27
	4.5.26	Board A14 High Frequency Adjustment (Figure 4-10)	4-28
	4.5.27	Board A13 High Frequency Adjustment (Figure 4-10)	4-28
	4.5.28	Board A12 High Frequency Adjustment (Figure 4-10)	4-28
	4.5.29	Board A8 Adjustment (Figure 4-12)	4-28
	4.5.30	Boards A10 and A11 Adjustments (Figures 4-13, 4-14, and 4-15)	4-30
	4.5.31	Board A7 Adjustment (Figure 4-16)	4-35

CONTENTS - Continued

Section			Page
	4.5.32	A1A2 Adjustment (Figure 4-3)	4-37
	4.5.33	Calibration of TCXO (Figure 4-17)	4-38
4.6	Fault Isolation Procedures		4-38
	4.6.1	PWR Indicator Failure (4.4.1b)	4-40
	4.6.2	Beat Indicator Failure (4.4.2b) and 0-1 kHz Tone Failure (4.4.2c)	4-40
	4.6.3	Audio Tone Fails to Increase (4.4.2d)	4-40
	4.6.4	No Output From Remote Speaker/ Headset (4.4.2e)	4-40
	4.6.5	Frequency not within Tolerance (4.4.3f-m)	4-41
	4.6.6	All Output Levels not within Tolerance (4.4.4d,e)	4-42
	4.6.7	Some Output Levels not within Tolerance (4.4.4d,e)	4-42
	4.6.8	Insufficient Carrier Level Control (4.4.5.1g)	4-42
	4.6.9	Insufficient AM Sensitivity (4.4.5.2e)	4-43
	4.6.10	Excessive AM Distortion (4.4.5.3c)	4-43
	4.6.11	Insufficient FM Sensitivity (4.4.6h)	4-43
	4.6.12	Measure Input Sensitivity not within Tolerance (4.4.7d)	4-43
	4.6.13	Overload Indication not within Tolerance (4.4.7e)	4-43
V	FM-10 SCHEMATIC DIAGRAMS		5-1
VI	PARTS LIST		6-1
VII	OAM-1 INSTALLATION		7-1
	7.1	Installation Procedure	7-1
VIII	OAM-1 THEORY OF OPERATION		8-1
	8.1	Introduction	8-1
	8.2	Theory of Operation	8-1

CONTENTS - Continued

Section			Page
	8.2.1	General	8-1
	8.2.2	Vertical Deflection Circuitry	8-1
	8.2.3	Horizontal Deflection Circuitry	8-2
	8.2.4	Internal Modulation Circuitry	8-3
	8.2.5	Power Supply Circuitry	8-3
IX	OAM-1 MAINTENANCE		9-1
9.1	Introduction		9-1
9.2	General Maintenance Information		9-1
	9.2.1	Basic Requirements	9-1
	9.2.2	Test Equipment	9-1
9.3	Minimum Performance Checkout Procedure		9-1
	9.3.1	Removal From Case	9-1
	9.3.2	Power Requirements	9-1
	9.3.3	Focus and Intensity	9-3
	9.3.4	Vertical and Horizontal Position Control Range	9-3
	9.3.5	Sweep Range	9-3
	9.3.6	Vertical Sensitivity	9-4
	9.3.7	Vertical Amplifier Frequency Response	9-5
	9.3.8	Carrier Level Control	9-5
	9.3.9	Modulation Measurement Accuracy	9-6
	9.3.10	Mainframe (Internal) Modulation Capability and Recovered Audio Distortion	9-7
	9.3.11	External Modulation Capability, Frequency Response, and Recovered Audio Distortion	9-8
	9.3.12	External Horizontal Sweep Capability	9-9
	9.3.13	Audio Output Frequency, Level, and Distortion	9-9
9.4	Alignment and Adjustment		9-10

CONTENTS - Continued

Section			Page
	9.4.1	Horizontal Amplifier Board Assembly A4 (Figure 9-1)	9-10
	9.4.2	Vertical Amplifier Board Assembly A3 (Figure 9-2)	9-12
	9.4.3	AM Detector Board Assembly A1 (Figure 9-3)	9-14
9.5	Fault Isolation Procedures		9-19
	9.5.1	No Trace (9.3.3-f)	9-19
	9.5.2	Focus Defective (9.3.3-g)	9-20
	9.5.3	Intensity Defective (9.3.3-g)	9-20
	9.5.4	Vertical Centering Defective (9.3.3-f)	9-21
	9.5.5	Horizontal Centering Defective (9.3.3-f)	9-21
	9.5.6	Vert Pos Control Cannot Adjust Trace Off Screen (9.3.4-b)	9-21
	9.5.7	Horiz Pos Control Cannot Adjust Trace to Mid-Screen (9.3.4-c)	9-22
	9.5.8	Sweep Speed Cannot Adjust Below 50 Hz on Low Range (9.3.5-h)	9-22
	9.5.9	Sweep Speed Cannot Adjust Above 5000 Hz on High Range (9.3.5-m)	9-22
	9.5.10	Sweep Speed Cannot Adjust Below 500 Hz on High Range (9.3.5-q)	9-22
	9.5.11	Sweep Speed Cannot Adjust Above 500 Hz on Low Range (9.3.5-u)	9-22
	9.5.12	External Vertical Input Sensitivity not within Specification Limits (9.3.6-d)	9-22
	9.5.13	Trace Cannot Adjust to Vert Set Line in Vert Set Mode (9.3.8-e)	9-23
	9.5.14	Carrier Level Control Cannot Set Trace Properly in Carrier Set Mode (9.3.8-h, 1, p)	9-23
	9.5.15	Trace Not on CRT Centerline when Measuring Unmodulated Signal (9.3.8-t)	
	9.5.16	AM does not Measure within Specified Accuracy (9.3.9-j, r)	9-24

CONTENTS - Continued

Section			Page
	9.5.17	Trace Cannot Set on CRT Carrier Set Line with Mainframe in Calibrate Mode (9.3.10-e)	9-24
	9.5.18	Unit Cannot Modulate Full Scale on CRT Using Internal Source (9.3.10-k)	9-24
	9.5.19	Modulation Distortion Exceeds 3% at 30% Modulation (9.3.10-n)	9-25
	9.5.20	External Modulation Sensitivity not within Specification Limits (9.3.11-g)	9-25
	9.5.21	External Horizontal Input Sensitivity not within Specification Limits (.3.12-c)	9-26
	9.5.22	Frequency of Internal 1-kHz Tone not within Specification Limits (9.3.13-f)	9-26
	9.5.23	Audio Output Less than 1 V RMS into 600Ω Load at 1 kHz (9.3.13-f)	9-26
	9.5.24	Audio Distortion Greater than 1% at 1-kHz (9.3.13-h)	9-26
	9.5.25	Internal 400-Hz Frequency not within Specification Limit (9.3.13-m)	9-26
	9.5.26	Audio Output Less than 1 V RMS into 600Ω Load at 1 kHz (9.3.13-n)	9-26
	9.5.27	Audio Distortion Greater than 1% at 400 Hz (9.3.13-p)	9-26
	9.5.28	Power Supply Board Assembly A2	9-26
X	OAM-1 SCHEMATIC DIAGRAM		10-1
XI	OAM-1 PARTS LIST		11-1
XII	ODM-1 INSTALLATION		12-1
	12.1 Installation Procedure		12-1
XIII	ODM-1 THEORY OF OPERATION		13-1
	13.1 Introduction		13-1
	13.2 Theory of Operation		13-1
	13.2.1	General	13-1
	13.2.2	Operate and Overload Lamp Circuitry	13-2
	13.2.3	Discriminator Output Circuitry	13-2

Section			Page
	13.2.4	Vertical Deflection Circuitry	13-2
	13.2.5	Horizontal Deflection Circuitry	13-3
	13.2.6	Internal Modulation Circuitry	13-3
	13.2.7	Power Supply Circuitry	13-4
XIV	ODM-1 MAINTENANCE		14-1
	14.1	Introduction	14-1
	14.2	General Maintenance Information	14-1
	14.2.1	Basic Requirements	14-1
	14.2.2	Test Equipment	14-1
	14.3	Minimum Performance Checkout Procedure	14-1
	14.3.1	Removal from Case	14-1
	14.3.2	Power Requirements	14-1
	14.3.3	Focus and Intensity	14-3
	14.3.4	Vertical and Horizontal Center Control Range	14-3
	14.3.5	Sweep Range	14-4
	14.3.6	Vertical Sensitivity	14-5
	14.3.7	Vertical Amplifier Frequency Response	14-5
	14.3.8	Sensitivity Check	14-5
	14.3.9	5 KHz Range Gain Check (FM-10)	14-6
	14.3.10	15 KHz Range Gain Check (FM-10)	14-6
	14.3.11	5 KHz Range Gain Check (FM-10C)	14-7
	14.3.12	15 KHz Range Gain Check (FM-10C)	14-7
	14.3.13	Internal Modulation and Vertical Gain Check (FM-10)	14-7
	14.3.14	Internal Modulation and Vertical Gain Check (FM-10C)	14-8
	14.3.15	Internal/Combined and External Mode Check (FM-10)	14-8
	14.3.16	Internal/Combined and External Mode Check (FM-10C)	14-8
	14.3.17	External Horizontal Sweep Capability	14-9

CONTENTS - Continued

Section			Page
	14.3.18	Audio Output Frequency, Level, and Distortion	14-9
14.4		Alignment and Adjustment	14-10
	14.4.1	Horizontal Amplifier Board Assembly A4	14-10
	14.4.2	IF Amplifier Board Assembly A1	14-12
	14.4.3	Vertical Amplifier Board Assembly A3	14-15
14.5		Fault Isolation Procedures	14-17
	14.5.1	No Trace	14-18
	14.5.2	Focus Defective	14-18
	14.5.3	Intensity Defective	14-19
	14.5.4	Vertical Centering Defective	14-19
	14.5.5	Horizontal Centering Defective	14-20
	14.5.6	Vert Center Control Cannot Adjust Trace Off Screen	14-20
	14.5.7	Horiz Center Control Cannot Adjust Trace to Mid-screen	14-20
	14.5.8	Sweep Speed Cannot Adjust Below 50 Hz on Low Range	14-20
	14.5.9	Sweep Speed Cannot Adjust Above 5000 Hz on High Range	14-20
	14.5.10	Sweep Speed Cannot Adjust Below 500 Hz on High Range	14-21
	14.5.11	Sweep Speed Cannot Adjust Above 500 Hz on Low Range	14-21
	14.5.12	External Vertical Input Sensitivity Not Within Specification	14-21
	14.5.13	Vertical Amplifier Frequency Response Not Within Specification	14-21
	14.5.14	Operate Indicator Sensitivity not Within Specification	14-21
	14.5.15	Overload Indicator Sensitivity not Within Specification	14-22
	14.5.16	5 KHz Positive Range not Within Specification	14-22
	14.5.17	5 KHz Negative Range not Within Specification	14-22

CONTENTS - Continued

Section		Page
	14.5.18 15 KHz Positive Range not Within Specification	14-23
	14.5.19 15 KHz Negative Range not Within Specification	14-23
	14.5.20 Insufficient Vertical Amplitude at 15 KHz	14-23
	14.5.21 Insufficient Vertical Amplitude at 5 KHz in external Mode with FM-10	14-24
	14.5.22 Insufficient Vertical Amplitude at 5 KHz in external Mode with FM-10C	14-24
	14.5.23 External Horizontal Sensitivity not Within Specification	14-24
	14.5.24 Audio Output Frequency Not Within Specification	14-24
	14.5.25 Audio Output Voltage not Within Specification	14-25
	14.5.26 Audio Distortion not Within Specification	14-25
	14.5.27 High Voltage Power Supply Board Assembly A2	14-25
XV	ODM-1 SCHEMATIC DIAGRAM	15-1
XVI	ODM-1 PARTS LIST	16-1

ILLUSTRATIONS

Figure		Page
1-1	FM-2748 (OAM-1 Plugged IN) and ODM-1	1-1
2-1	FM-2748 Left Hand Module A1, Functional Diagram	2-2
2-2	A1A4 Assembly, Location Diagram	2-5
2-3	Left-Hand Module (A1), Schematic Diagram	2-13
2-4	Divider and Automatic Level Control (A1A2), Schematic Diagram	2-15
2-5	Power Supply, AF and IF Amplifier (A1A3), Schematic Diagram	2-17
2-6	Broad Band Amplifier and Detector (A1A4), Schematic Diagram	2-19

ILLUSTRATIONS - Continued

Figure		Page
2-7	TCXO and Buffer Amplifier (A11), Schematic Diagram	2-21
3-1	Typical Frequency Synthesis	3-2
3-2	Overall Functional Diagram	3-11
4-1	A11 - A21 Board Locations	4-9
4-2	A1A3 Board, Location Diagram	4-10
4-3	A1A2 Board, Location Diagram	4-11
4-4	A1A4 Assembly, Location Diagram	4-13
4-5	A2 Board, Location Diagram	4-15
4-6	A3, A4, and A5 Board, Location Diagram	4-17
4-7	A6 Board, Location Diagram	4-19
4-8	A21 Board, Location Diagram	4-21
4-9	A16 - A20 Boards, Location Diagram	4-22
4-10	A12 - A15 Boards, Location Diagram	4-24
4-11	A7/A8 Assembly, Location Diagram	4-26
4-12	A8 Board, Location Diagram	4-29
4-13	A10 Assembly, Access Hole Identification	4-31
4-14	A10 Assembly, Location Diagram	4-32
4-15	A11 Board, Location Diagram	4-33
4-16	A7 Board, Location Diagram	4-36
4-17	Access to TCXO	4-39
5-1	Left-Hand Module (A1), Schematic Diagram	5-3
5-2	Divider and Automatic Level Detector (A1A2), Schematic Diagram	5-5
5-3	Power Supply, AF and IF Amplifier (A1A3), Schematic Diagram	5-7
5-4	Board Band Amplifier and Detector (A1A4), Schematic Diagram	5-9
5-5	VCO and 6- and 9-MHz Generators (A2), Schematic Diagram	5-11
5-6	1, 10, and 100 kHz Decades (A3, A4, A5), Schematic Diagram	5-13
5-7	1 MHz Decade (A6), Schematic Diagram	5-15

ILLUSTRATIONS - Continued

Figure		Page
5-8	Gain Control Amplifier (A7), Schematic Diagram	5-17
5-9	10 MHz Decade (A8), Schematic Diagram	5-19
5-10	Diode Switch (A9), Schematic Diagram	5-21
5-11	100 MHz Decade (A10), Schematic Diagram	5-23
5-12	TCXO and Buffer Amplifier (A11), Schematic Diagram	5-25
5-13	Frequency Generator (A12 - A21), Schematic Diagram	5-27
5-14	Frequency Selector Switches (S1, A22 - A24), Schematic Diagram	5-29
6-1	Exploded Isometric Diagram, Mainframe (A1 Removed)	6-2
6-2	Exploded Isometric Diagram Assembly A1, Left-Hand Module	6-3
8-1	Detailed Block Diagram, Model OAM-1	8-5
9-1	Horizontal Amplifier Board Assembly A4	9-11
9-2	Vertical Amplifier Board Assembly A3	9-13
9-3	AM Detector Board Assembly A1	9-15
9-4	Power Supply Board Assembly A2	9-27
10-1	OAM-1, Schematic Diagram	10-3
13-1	Detailed Block Diagram, Model ODM-1	13-5
14-1	Horizontal Amplifier Board Assembly A4	14-11
14-2	IF Amplifier Board Assembly A1	14-13
14-3	Vertical Amplifier Board Assembly A3	14-16
14-4	Power Supply Board Assembly A2	14-26
15-1	ODM-1, Schematic Diagram	15-3

TABLES

Table		Page
4-1	FM-10 Test Equipment Requirements	4-3
4-2	Decade Fault Isolation Chart	4-41
4-3	Digit Fault Isolation Chart	4-41
9-1	OAM-1 Test Equipment Requirements	9-2
14-1	ODM-1 Test Equipment Requirements	14-2

SECTION I

INTRODUCTION

1.1 GENERAL

This manual contains theory of operation, maintenance, schematic diagrams and parts lists for the FM-2748 system (Mainframe with OAM-1 plug-in module) and plug-in module ODM-1. See Figure 1-1. Difference data, Section II, provides material to convert the FM-10 Mainframe sections of the manual to the FM-2748 configuration. The OAM-1 and ODM-1 sections of the manual require no difference data other than their references to the Mainframe: where FM-10 Mainframe is noted, substitute Mainframe: where FM-10C is noted, ignore.

Refer to Operators Instruction Manual for Model FM-2748/ODM-1, manual number 500783-250, for complete operating instructions and specifications.

07975

Figure 1-1. FM-2748 (OAM-1 Plugged In) and ODM-1.

SECTION II

DIFFERENCE DATA

This section contains data defining the differences between the FM-10 Mainframe, presented in sections III through VI, and the FM-2748 Mainframe. By making the changes noted in this section, the FM-10 sections may be converted to FM-2748 Mainframe documents.

2.1 THEORY OF OPERATION DIFFERENCES

Page 3-1, paragraph 3.2: Change "loudspeaker, and fixed and variable RF output attenuators" to read "loudspeaker, and 10 and 1 db step and 0-1 db variable RF output attenuators."

Page 3-1, paragraph 3.3: Change "is supplied via variable attenuator AT2 to J2, the RF output attenuator" to read "is supplied via attenuator AT1 and RF fuse F3 to J2, the RF output attenuator."

Page 3-1, paragraph 3.4: Change "is amplified by Q1, Q2, and Q3" to read "is amplified by Q2, Q4, Q6, and Q8".

Page 3-1, paragraph 3.5: Change "(MEASURE INPUT) to a detector CR2 on assembly A1A4 which acts as a mixer. In CR2, the" to read "(MEASURE INPUT) to a doubly balanced mixer X1 on assembly A1A4. In X1, the". Change "switch S11. When S11" to read "switch S11. In either position of S11, the beat lamp amplifier consisting of A1A2U7 and A1A2Q9 may be operated. When S11". Change "at loudspeaker LS1 and the beat indicator following amplification" to read "at loudspeaker LS1 following amplification". Change "S11 switches the beat indicator and loudspeaker circuit" to read "S11 switches the loudspeaker circuit".

Page 3-9, paragraph 3.18: Add at end of last paragraph of 3.18: "When TIMEBASE switch A11S1 is in the INT position, the 10 MHz signal at terminal A11-36 is connected to TIMEBASE jack A11J1. When the switch is at EXT, an external timebase may be supplied to the FM-2748 via TIMEBASE jack A11J1."

Page 3-11, Figure 3-2: Modify A1 section of block diagram to conform with Figure 2-1, FM-2748 Left-Hand Module A1.

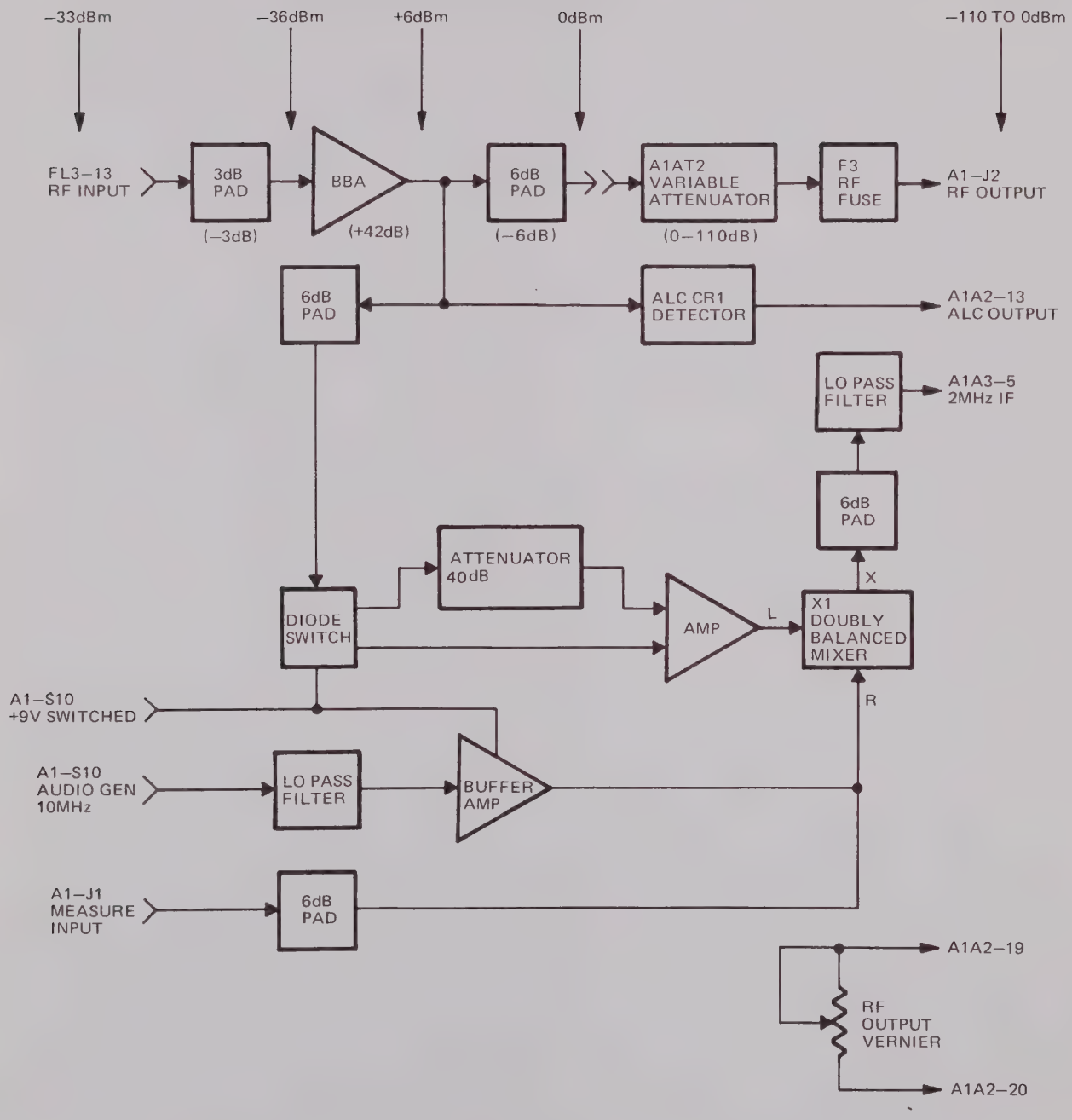


Figure 2-1. FM-2748 Left Hand Module A1, Functional Diagram

2.2 MAINTENANCE DIFFERENCES

Page 4-4, Table 4-1: Delete from table:

Broadband Amplifier	Gain: 20 db minimum from 50 kHz to 500 MHz	Singer Model BBA-1

Add to end of table:

Signal Source	Frequency: 10 MHz Impedance: 1 k ohm Level: 400 mV rms Accuracy: ±10%	NA

Page 4-5: Delete steps 4-4.3-a, b & d and substitute the following:

a. Connect the Mainframe RF OUTPUT jack to the frequency counter input jack with a 50Ω coaxial cable.

b. Set the RF OUTPUT control to 0 dBM.

Steps e through m become steps d through l.

Page 4-5: Delete steps following "4.4.4 OUTPUT LEVEL CHECK." and substitute the following:

"a. Connect RF Voltmeter to RF OUTPUT jack.

b. Set RF OUTPUT level at -10 dbm and set RF OUTPUT VERNIER control at CAL.

c. Set frequency controls at 100.000 MHz and set 0-1 kHz frequency control at OUT.

d. Verify that RF Voltmeter indicates -10 dbm ±2 db.

e. Set frequency controls for all frequencies in steps g through m of paragraph 4.4.3 and verify that levels are -10 dbm ±2 db for each frequency setting.

f. Set frequency controls at 10.000 MHz.

g. Note output level and set RF OUTPUT LEVEL at 0 dbm and -20 dbm.

h. Verify that RF Voltmeter indicates 0 dbm and -20 dbm ±2 db, respectively."

Page 4-7: Following the steps of paragraph 4.4.7, add the following:

"4.4.8 INT/EXT TIMEBASE SWITCH CHECK.

a. Set TIMEBASE switch at INT and measure 10-MHz signal level at TIMEBASE jack with RF Voltmeter.

b. Verify that RF Voltmeter indicates 175 mV rms minimum.

c. Set TIMEBASE switch at EXT and connect 10-MHz source to TIMEBASE jack. Set frequency controls at 10.001 MHz.

d. Press 10 MHz switch to IN and verify that a 1-kHz tone is audible from speaker."

Page 4-12, paragraph 4.5.2-p: Change to read: "Connect RF Voltmeter with 50Ω termination to the RF OUTPUT jack and set output attenuator to 0 dBM."

Page 4-12, paragraph 4.5.2.q: Change "Adjust A1A2-R31 for an RF Voltmeter indication of -23 dbm." to read "Adjust A1A2-R31 for a reading of 0 dbm.

Page 4-13, paragraph 4.5.3-e: Change to read: "Set mainframe and signal generator frequencies to 1 MHz. Connect RF Voltmeter with 50Ω termination to RF OUTPUT jack. Set OUTPUT ATTENUATOR to 0 dBM and verify that the level is 0 dBM ±1 dB".

Page 4-13, paragraph 4.5.3.f: Change "Verify that level is -23 dbm ±1 db." to read "Verify that level is 0 dbm ±1 db."

Page 4-13, paragraph 4.5.3.g: Change "Level should be -23 dbm ±1 db between 1 MHz and 500 MHz." to read "Level should be 0 dbm ±1 db between 1 MHz and 500 MHz."

Page 4-13, Replace Figure 4-4 with page 2-5, Figure 2-2, A1A4 Assembly Location Diagram.

Page 4-14, paragraph 4.5.4-f: Change to read: "Connect RF OUTPUT jack to Frequency Counter Input."

Page 4-37, paragraph 4.5.32-b: Change to read: "Connect RF Voltmeter to RF OUTPUT jack."

Page 4-37, paragraph 4.5.32.c: Change "an output of -23 dbm" to read "an output of 0 dbm".

Page 4-38, paragraph 4.5.33.1-a: Change to read: "Connect RF OUTPUT jack to Frequency Counter Input.

Page 4-38: Following paragraph 4.5.33.2, add:

"4.5.34 EXTERNAL TIMEBASE CHECK.

a. Connect a 10 MHz signal source at -3 dbm to TIMEBASE jack.

b. Set frequency controls at 10.001 MHz.

c. Set TIMEBASE switch at EXT and press 10 MHz switch to IN.

d. Verify that a 1 kHz tone is audible from speaker".

Page 4-42, paragraph 4.6.6-a: Change to read: "Verify that RF OUTPUT is 0 dBM ±1 dB".

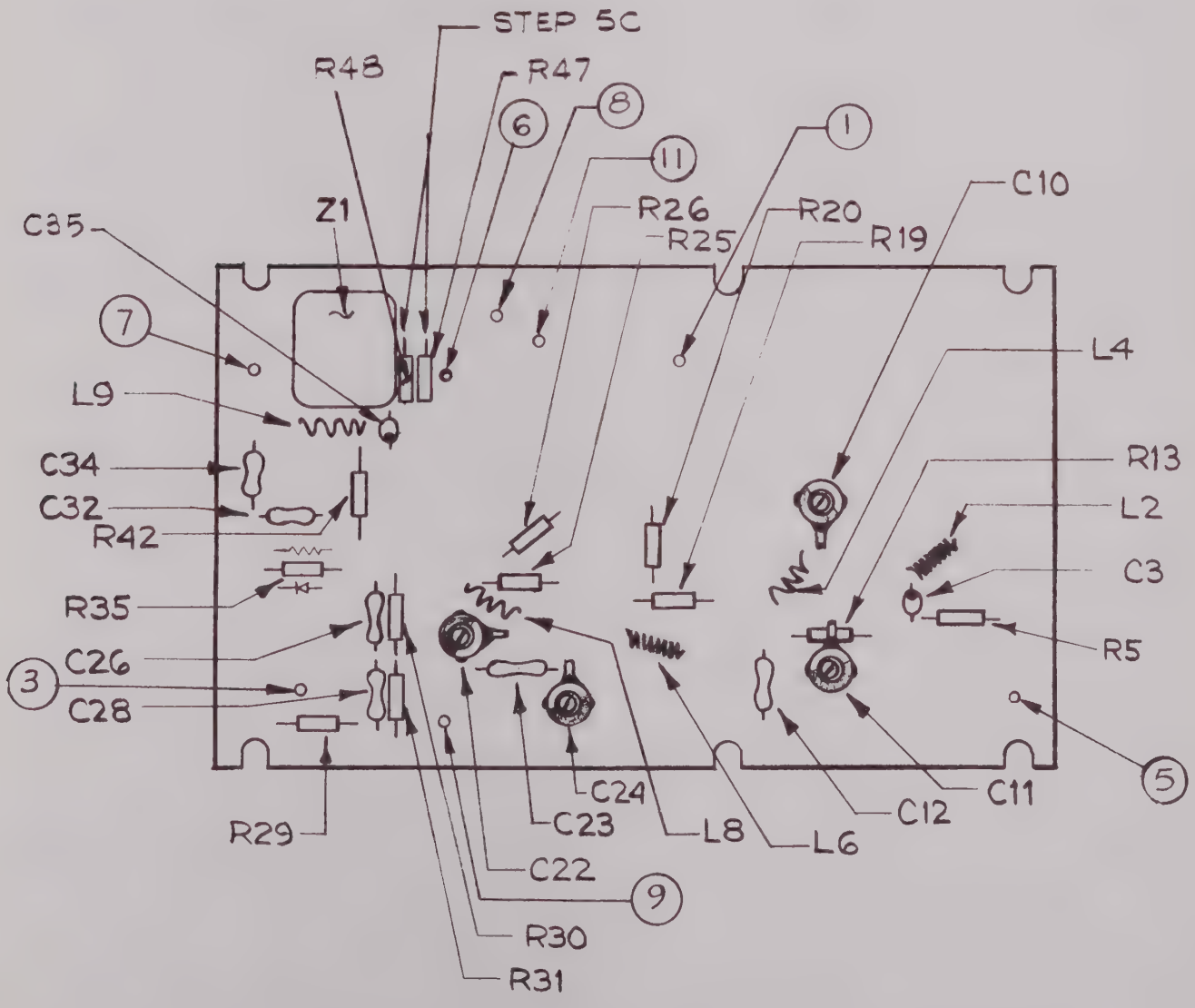


Figure 2-2. A1A4 Assembly, Location Diagram

Page 4-42, paragraph 4.6.6-b: Delete entire contents and change to: "If this level is within tolerance and output is out of tolerance, check RF fuse F3. If fuse is not defective, replace attenuator A1AT2."

Page 4-42: At the end of paragraph 4.6.6, add the following step: "d. If output level does not vary 10 db (±1 db) when attenuator is set at 0 dbm and -20 dbm, replace attenuator A1AT2."

Page 4-43: Following paragraph 4.6.13, add the following paragraphs:

"4.6.14 LEVEL AT TIMEBASE JACK OUT OF TOLERANCE (4.4.8.b). Check TIMEBASE switch and associated circuitry if level at TIMEBASE jack is out of tolerance.

4.6.15 1 kHz TONE ABSENT (4.4.8.d). Check TIMEBASE switch and associated circuitry."

2.3 SCHEMATIC DIAGRAM DIFFERENCES

Page 5-3, Figure 5-1: Replace page 5-3 with page 2-13, Figure 2-3, Left-Hand Module (A1), Schematic Diagram.

Page 5-5, Figure 5-2: Replace page 5-5 with page 2-15, Figure 2-4, Divider and Automatic Level Control (A1A2), Schematic Diagram.

Page 5-7, Figure 5-3: Replace page 5-7 with page 2-17, Figure 2-5, Power Supply, AF and IF Amplifier (A1A3), Schematic Diagram.

Page 5-9, Figure 5-4: Replace page 5-9 with page 2-19, Figure 2-6, Broad Band Amplifier and Detector (A1A4), Schematic Diagram.

Page 5-25, Figure 5-12: Replace page 5-25 with page 2-21, Figure 2-7, TCXO and Buffer Amplifier (A11), Schematic Diagram.

2.4 PARTS LIST DIFFERENCES

Page 6-1, Main Assembly: Substitute the following items:

FM-2748 MAIN ASSEMBLY

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
A1	Left Hand Module Assy	004677-001	Singer		1
A11	TCXO & Buffer Amp. Assy	003089-008	Singer		1

Page 6-4 and 6-5, Left-Hand Module Assembly A1: Substitute or add, as necessary, the following items:

LEFT HAND MODULE, ASSEMBLY A1

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
A2	Dividers & Auto. Level Control Assy	003078-008	Singer		1
A3	Power Supply & AF & IF Amplifier Assy	003079-008	Singer		1
A4	Broadband Amp. & Doubly Balanced Mixer Assy	004676-005	Singer		1
AT1	Attenuator, Dual Concentric	403416-001	Texscan	RA-574	1
C8	Capacitor, Feed-through .001 μF	900038-001	Allen-Bradley	Type FB2B-102w	1
C40	Capacitor, Dipped Mica 82 pF	900003-028	Electromotive	DM-15	1
C41	Capacitor, Dipped Mica 10 pF	900003-008	Electromotive	DM-15	1
C42	Capacitor, Dipped Mica 24 pF	900003-014	Electromotive	DM-15	1
C43	Capacitor, Dipped Mica 200 pF	900003-037	Electromotive	DM-15	1
F3	Fuse, Attenuator Link	403417-001	Texscan	FP-50-F	1
J2	Part of F3				1
L12	Choke, 22 μH	906003-029	Nytronics	DD-22	1
L13	Choke, 10 μH	906003-025	Nytronics	DD-10	1
R1	Resistor, Variable 5k ohms	403419-001	CTS	Type 550	1
R2	Resistor, Carbon - Selected	945000-000	Allen-Bradley	Type CB	1
W1	Cable Assembly	004683-001	Singer		1

Page 6-9, 6-10, and 6-11, Power Supply, AF and IF Amplifier Assembly A1A3: Substitute or add, as necessary, the following items:

POWER SUPPLY, A.F. & I.F. AMPLIFIER, ASSEMBLY A1A3

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
C13	Capacitor, Dipped Mica 390 pF	900003-045	Electromotive	DM-15	1
L2	Choke, 15 μH	906002-017	J.W. Miller	70F15.5AI	1
R14	Resistor, Carbon 150 ohm	945000-027	Allen-Bradley	Type CB	1
R22	Resistor, Carbon 100 ohm	945000-025	Allen-Bradley	Type CB	1
R30	Resistor, Variable 500 ohm	945007-003	CTS	Type X201	1

Pages 6-11 and 6-12, Broad Band Amplifier and Detector Assembly A1A4: Substitute with the following items:

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
C1, C2, C3	Capacitor, Polarized 0.1 μF	900115-002	Dickson	DR10GSA50M	3
C4	Capacitor, Polarized 1.0 μF	900115-003	Dickson	DR10GSA50M	1
C5	Capacitor, Polarized 0.1 μF	900115-002	Dickson	DR10GSA50M	1
C6	Capacitor, Polarized 1.0 μF	900115-003	Dickson	DR10GSA50M	1
C7, C8, C9	Capacitor, Polarized 0.1 μF	900115-002	Dickson	DR10GSA50M	3
C10, C11	Capacitor, Variable Ceramic 1.7-11 pF	900113-002	JFD	DVJ302A	2
C12	Capacitor, Selected 5 pF Nominal	900003-004	Electromotive	Type DM-15	1
C13	Capacitor, Polarized 1.0 μF	900115-003	Dickson	DR10GSA50M	1
C14, C15, C16	Capacitor, Polarized 0.1 μF	900115-002	Dickson	DR10GSA50M	3
C17, C18	Capacitor, Polarized 1.0 μF	900115-003	Dickson	DR10GSA50M	2
C19, C20, C21	Capacitor, Polarized 0.1 μF	900115-002	Dickson	DR10GSA50M	3
C22	Capacitor, Variable 1.7-11 pF	900113-002	JFD	DVJ302A	1
C23	Capacitor, Selected 5 pF Nominal	900003-004	Electromotive	Type DM-15	1
C24	Capacitor, Variable 1.7-11 pF	900113-002	JFD	DVJ302A	1
C25	Capacitor, Polarized 1.0 μF	900115-003	Dickson	DR10GSA50M	1
C26	Capacitor, Selected, Tubular	900066-000	Quality Comp.	MC Series	1
C27	Capacitor, Metalized Plastic .047 μF	900001-009	Amperex	Type C280AE	1
C28	Capacitor, Selected	900003-000	Electromotive	Type DM-15	1
C29	Capacitor, Polarized 1.0 μF	900115-003	Dickson	DR10GSA50M	1
C30	Capacitor, Polarized 0.1 μF	900115-002	Dickson	DR10GSA50M	1
C31	Capacitor, Polarized 1.0 μF	900115-003	Dickson	DR10GSA50M	1
C32	Capacitor, Selected 5 pF Nominal	900003-004	Electromotive	Type DM-15	1
C33	Capacitor, Polarized 0.1 μF	900115-002	Dickson	DR10GSA50M	1
C34	Capacitor, Selected 10 pF Nominal	900003-008	Electromotive	Type DM-15	1
C35	Capacitor, Polarized 1.0 μF	900115-003	Dickson	DR10GSA50M	1
C36	Capacitor, Polarized 0.1 μF	900115-002	Dickson	DR10GSA50M	1
C37	Capacitor, Dipped Mica 5 pF	900003-004	Electromotive	Type DM-15	1
C38	Capacitor, Metalized Plastic .047 μF	900001-009	Amperex	Type C280AE	1
C39	Capacitor, Polarized 0.1 μF	900115-002	Dickson	DR10GSA50M	1
CR1	Diode, Back	913026-003	General Elect.	BD3	1

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
CR2, CR3	Diode, Switching	913074-001	ITT	ITT 244	2
L1	Choke, 1 mH	906016-049	Lenox-Fugle	DR-1000	1
L2	Coil, 8T	403283-007	Singer		1
L3	Choke, 1 mH	906016-049	Lenox-Fugle	DR-1000	1
L4	Coil, 4T	403283-001	Singer		1
L5	Choke, 1 mH	906016-049	Lenox-Fugle	DR-1000	1
L6	Coil, 8T	403283-007	Singer		1
L7	Choke, 470 µH	906032-045	Nytronics	WEE-470	1
L8, L9	Coil, 4T	403283-001	Singer		2
L10	Choke, 1 mH	906016-049	Lenox-Fugle	DR-1000	1
L11	Choke, 0.15 µH	906003-003	Nytronics	DD-0.15	1
Q1	Transistor	958000-002	Motorola	2N3906	1
Q2	Transistor	958018-001	Motorola	2N5179	1
Q3	Transistor	958000-002	Motorola	2N3906	1
Q4	Transistor	958018-001	Motorola	2N5179	1
Q5	Transistor	958000-002	Motorola	2N3906	1
Q6	Transistor	958064-001	Amperex	A486	1
Q7	Transistor	958000-002	Motorola	2N3906	1
Q8	Transistor	958081-001	Solid State Scientific	SD1005-1	1
Q9	Transistor	958080-001	Motorola	2N4427	1
R1	Resistor, Carbon 1.5k ± 5%, 1/4W	945000-166	Allen-Bradley	Type CB	1
R2	Resistor, Carbon 3.6k ± 5%, 1/4W	945000-175	Allen-Bradley	Type CB	1
R3	Resistor, Carbon 150Ω ± 5%, 1/4W	945000-142	Allen-Bradley	Type CB	1
R4	Resistor, Carbon 3.9k ± 5%, 1/4W	945000-176	Allen-Bradley	Type CB	1
R5	Resistor, Selected, 270Ω Nominal	945000-148	Allen-Bradley	Type CB	1
R6	Resistor, Carbon 16Ω ± 5%, 1/4W	945000-119	Allen-Bradley	Type CB	1
R7, R8	Resistor, Carbon 300Ω ± 5%, 1/4W	945000-149	Allen-Bradley	Type CB	1
R9	Resistor, Carbon 1.5k ± 5%, 1/4W	945000-166	Allen-Bradley	Type CB	1
R10	Resistor, Carbon 7.5k ± 5%, 1/4W	945000-183	Allen-Bradley	Type CB	1
R11	Resistor, Carbon 75Ω ± 5%, 1/4W	945000-135	Allen-Bradley	Type CB	1
R12	Resistor, Carbon 3.9k ± 5%, 1/4W	945000-176	Allen-Bradley	Type CB	1

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
R13	Resistor, Selected 270Ω Nominal	945000-148	Allen-Bradley	Type CB	1
R14	Resistor, Carbon 15Ω ± 5%, 1/4W	945000-118	Allen-Bradley	Type CB	1
R15	Resistor, Carbon 2.7k ± 5%, 1/4W	945000-172	Allen-Bradley	Type CB	1
R16	Resistor, Carbon 3.3k ± 5%, 1/4W	945000-174	Allen-Bradley	Type CB	1
R17	Resistor, Carbon 150Ω ± 5%, 1/4W	945000-142	Allen-Bradley	Type CB	1
R18	Resistor, Carbon 3.9kΩ ± 5%, 1/4W	945000-176	Allen-Bradley	Type CB	1
R19	Resistor, Selected 200Ω Nominal	945000-145	Allen-Bradley	Type CB	1
R20	Resistor, Carbon 1k ± 5%, 1/4W Sel.	945000-162	Allen-Bradley	Type CB	1
R21	Resistor, Carbon 1.3k ± 5%, 1/4W	945000-165	Allen-Bradley	Type CB	1
R22	Resistor, Carbon 3.3k ± 5%, 1/4W	945000-174	Allen-Bradley	Type CB	1
R23	Resistor, Carbon 27Ω ± 5%, 1/4W	945000-124	Allen-Bradley	Type CB	1
R24	Resistor, Carbon 3.9k ± 5%, 1/4W	945000-176	Allen-Bradley	Type CB	1
R25	Resistor, Carbon 120Ω ± 5%, 1/4W	945000-140	Allen-Bradley	Type CB	1
R26	Resistor, Carbon 1k ± 5%, 1/4W	945000-162	Allen-Bradley	Type CB	1
R27	Resistor, Carbon 13Ω ± 5%, 1/4W	945000-117	Allen-Bradley	Type CB	1
R28	Resistor, Carbon 100Ω ± 5%, 1/4W	945000-138	Allen-Bradley	Type CB	1
R29	Resistor, Carbon 4.7k ± 5%, 1/4W	945000-178	Allen-Bradley	Type CB	1
R30	Resistor, Carbon 560Ω ± 5%, 1/4W	945000-156	Allen-Bradley	Type CB	1
R31	Resistor, Carbon 68Ω ± 5%, 1/4W Sel.	945000-134	Allen-Bradley	Type CB	1
R32	Resistor, Film 49.9Ω ± 1%, 1/8W	945016-068	Allen-Bradley	RN60D	1
R33	Resistor, Carbon 51Ω ± 5%, 1/4W	945000-131	Allen-Bradley	Type CB	1
R34	Resistor, Carbon 56Ω ± 5%, 1/4W	945000-132	Allen-Bradley	Type CB	1
R35	Resistor, Carbon 5.6k ± 5%, 1/4W Sel.	945000-180	Allen-Bradley	Type CB	1
R36	Resistor, Carbon 430Ω ± 5%, 1/4W	945000-153	Allen-Bradley	Type CB	1
R37	Resistor, Carbon 1k ± 5%, 1/4W	945000-162	Allen-Bradley	Type CB	1
R38	Resistor, Carbon 430Ω ± 5%, 1/4W	945000-153	Allen-Bradley	Type CB	1
R39	Resistor, Carbon 470Ω ± 5%, 1/4W	945000-154	Allen-Bradley	Type CB	1
R40	Resistor, Carbon 10Ω ± 5%, 1/4W	945000-114	Allen-Bradley	Type CB	1
R41	Resistor, Carbon 2.4k ± 5%, 1/4W	945000-171	Allen-Bradley	Type CB	1
R42	Resistor, Carbon 110Ω ± 5%, 1/4W Sel.	945000-139	Allen-Bradley	Type CB	1
R43	Resistor, Carbon 47Ω ± 5%, 1/4W	945000-130	Allen-Bradley	Type CB	1
R44	Resistor, Carbon 1.7kΩ ± 5%, 1/4W	945000-172	Allen-Bradley	Type CB	1

BRAODBAND AMPLIFIER & DOUBLY BALANCED MIXED, ASSEMBLY A1A4 (CONT)

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
R45	Resistor, Carbon 6.2k ±5%, 1/4W Sel.	945000-181	Allen-Bradley	Type CB	1
R46	Resistor, Carbon 220Ω ±5%, 1/4W	945000-146	Allen-Bradley	Type CB	1
R47	Resistor, Carbon 39Ω ±5%, 1/4W	945000-128	Allen-Bradley	Type CB	1
R48, 49	Resistor, Carbon 150Ω ±5%, 1/4W	945000-142	Allen-Bradley	Type CB	1
R50	Resistor, Carbon 39Ω ±5%, 1/4W	945000-128	Allen-Bradley	Type CB	1
R51, 52	Resistor, Carbon 150Ω ±5%, 1/4W	945000-142	Allen-Bradley	Type CB	2
Z1	Mixer, Doubly Balanced	403442-001	VARI-L	SM-112B	1

Page 6-27, 6-28, and 6-29, TCXO and Buffer Amplifier Assembly A11: Substitute or add, as necessary, the following items:

TCXO AND BUFFER AMPLIFIER ASSEMBLY A11

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
A1	TCXO	402838-003	Motorola		1
C8	Not used				
C48	Capacitor, Dipped Mica 33 pF	900003-017	Electro Motive	DM-15	1
C49	Capacitor, metalized plastic 0.1 μF	900001-013	Amperex	Type C280AE	1
J1	Connector, receptacle BNC UG-911/U	910005-001		UG-911/U	1
S1	Switch, toggle DPDT	951036-027	C & K Comp.	7201-K	1

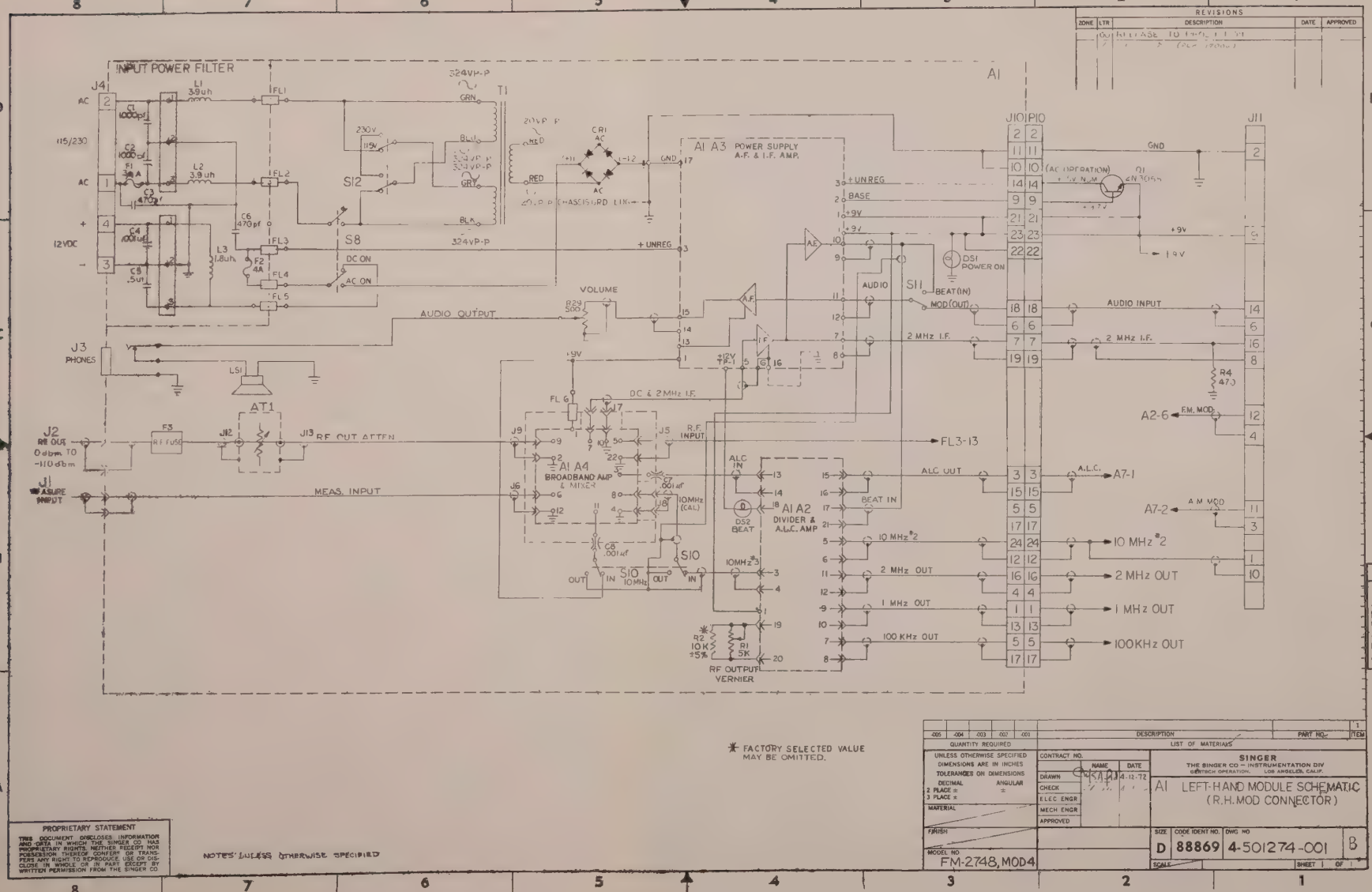


Figure 2-3. Left-Hand Module (A1), Schematic Diagram
2-13/2-14

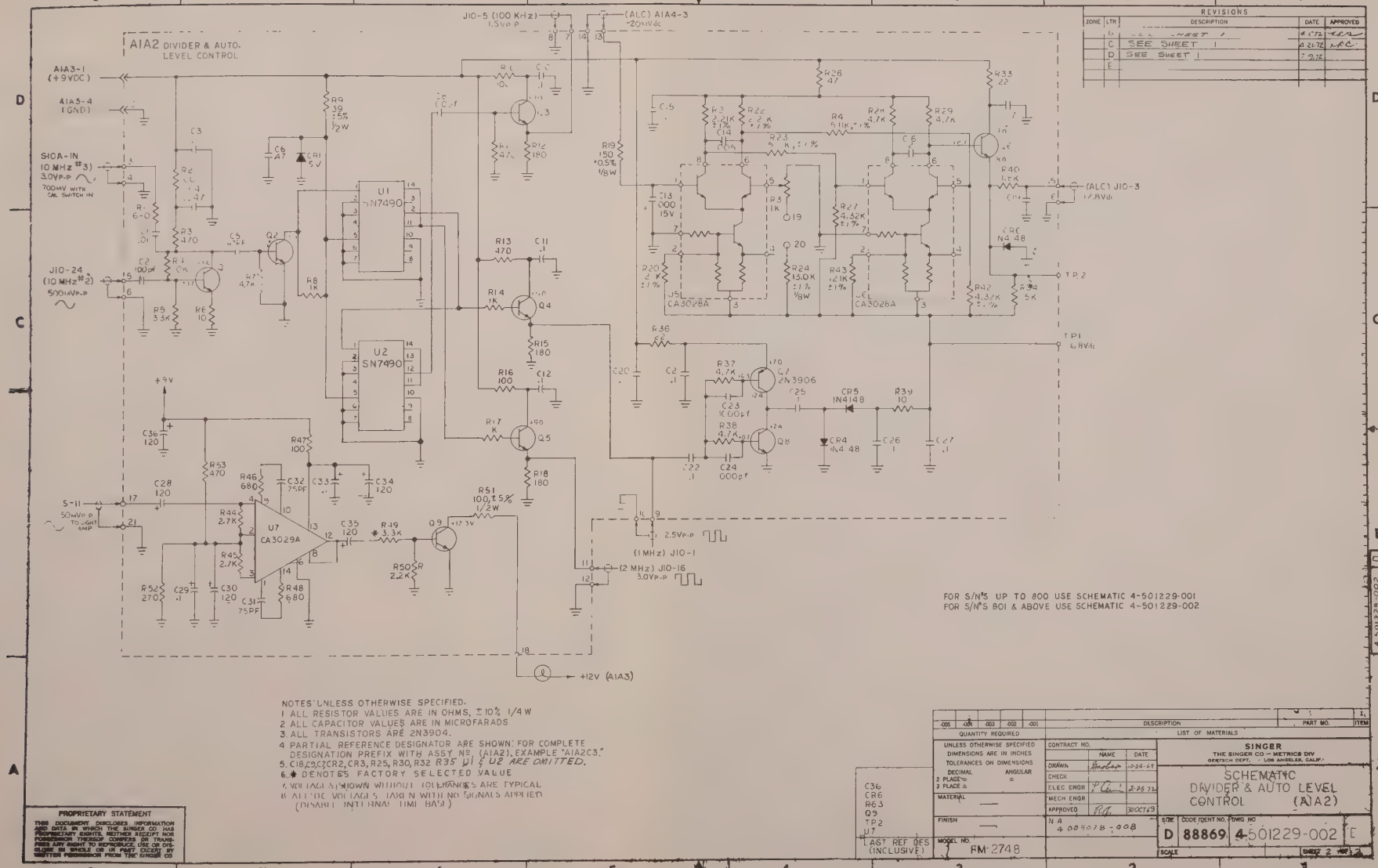
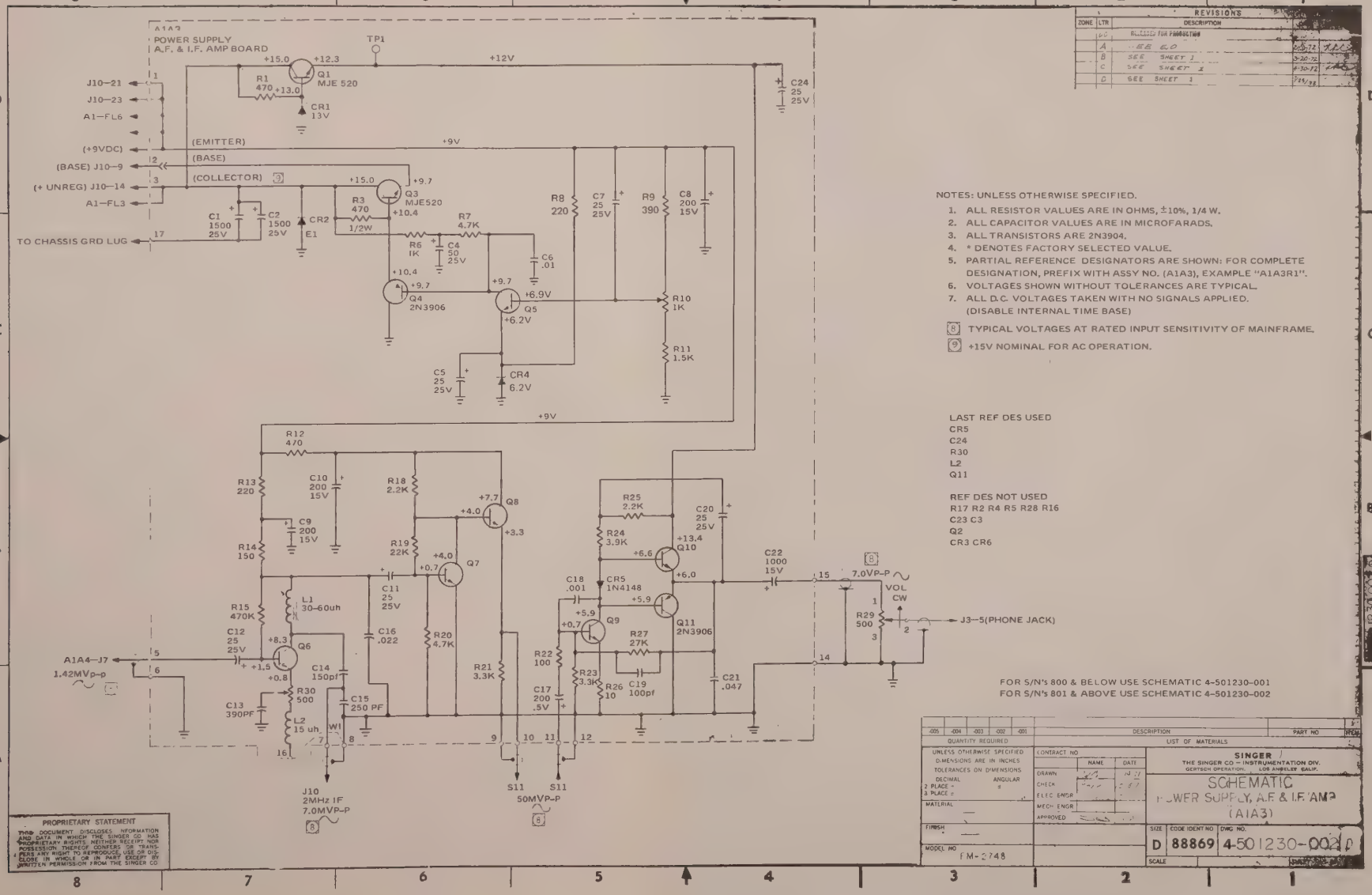


Figure 2-4. Divider and Automatic Level Control (A1A2), Schematic Diagram



REVISIONS			
ZONE	LTR	DESCRIPTION	
	-	RELEASED FOR PRODUCTION	
	A	SEE E.O.	3-20-72
	B	SEE SHEET 1	3-20-72
	C	SEE SHEET 1	4-30-72
	D	SEE SHEET 1	7/1/72

NOTES: UNLESS OTHERWISE SPECIFIED.

1. ALL RESISTOR VALUES ARE IN OHMS, ±10%, 1/4 W.
2. ALL CAPACITOR VALUES ARE IN MICROFARADS.
3. ALL TRANSISTORS ARE 2N3904.
4. * DENOTES FACTORY SELECTED VALUE.
5. PARTIAL REFERENCE DESIGNATORS ARE SHOWN: FOR COMPLETE DESIGNATION, PREFIX WITH ASSY NO. (A1A3), EXAMPLE "A1A3R1".
6. VOLTAGES SHOWN WITHOUT TOLERANCES ARE TYPICAL.
7. ALL D.C. VOLTAGES TAKEN WITH NO SIGNALS APPLIED. (DISABLE INTERNAL TIME BASE)

[8] TYPICAL VOLTAGES AT RATED INPUT SENSITIVITY OF MAINFRAME.

[9] +15V NOMINAL FOR AC OPERATION.

LAST REF DES USED
CR5
C24
R30
L2
Q11

REF DES NOT USED
R17 R2 R4 R5 R28 R16
C23 C3
Q2
CR3 CR6

FOR S/N's 800 & BELOW USE SCHEMATIC 4-501230-001
FOR S/N's 801 & ABOVE USE SCHEMATIC 4-501230-002

PROPRIETARY STATEMENT

THIS DOCUMENT DISCLOSES INFORMATION AND DATA IN WHICH THE SINGER CO HAS PROPRIETARY RIGHTS. NEITHER RECEIPT NOR POSSESSION THEREOF CONFERS OR TRANSFERS ANY RIGHT TO REPRODUCE, USE OR DISCLOSE IN WHOLE OR IN PART EXCEPT BY WRITTEN PERMISSION FROM THE SINGER CO

LIST OF MATERIALS

SINGER
THE SINGER CO — INSTRUMENTATION DIV.
GERTSCH OPERATION, LOS ANGELES, CALIF.

SCHEMATIC
POWER SUPPLY, A.F. & I.F. AMP
(A1A3)

SIZE	CODE IDENT NO	DWG NO.
D	88869	4-501230-002 D

SCALE

MODEL NO FM-2748

Figure 2-5. Power Supply, AF and IF Amplifier (A1A3), Schematic Diagram

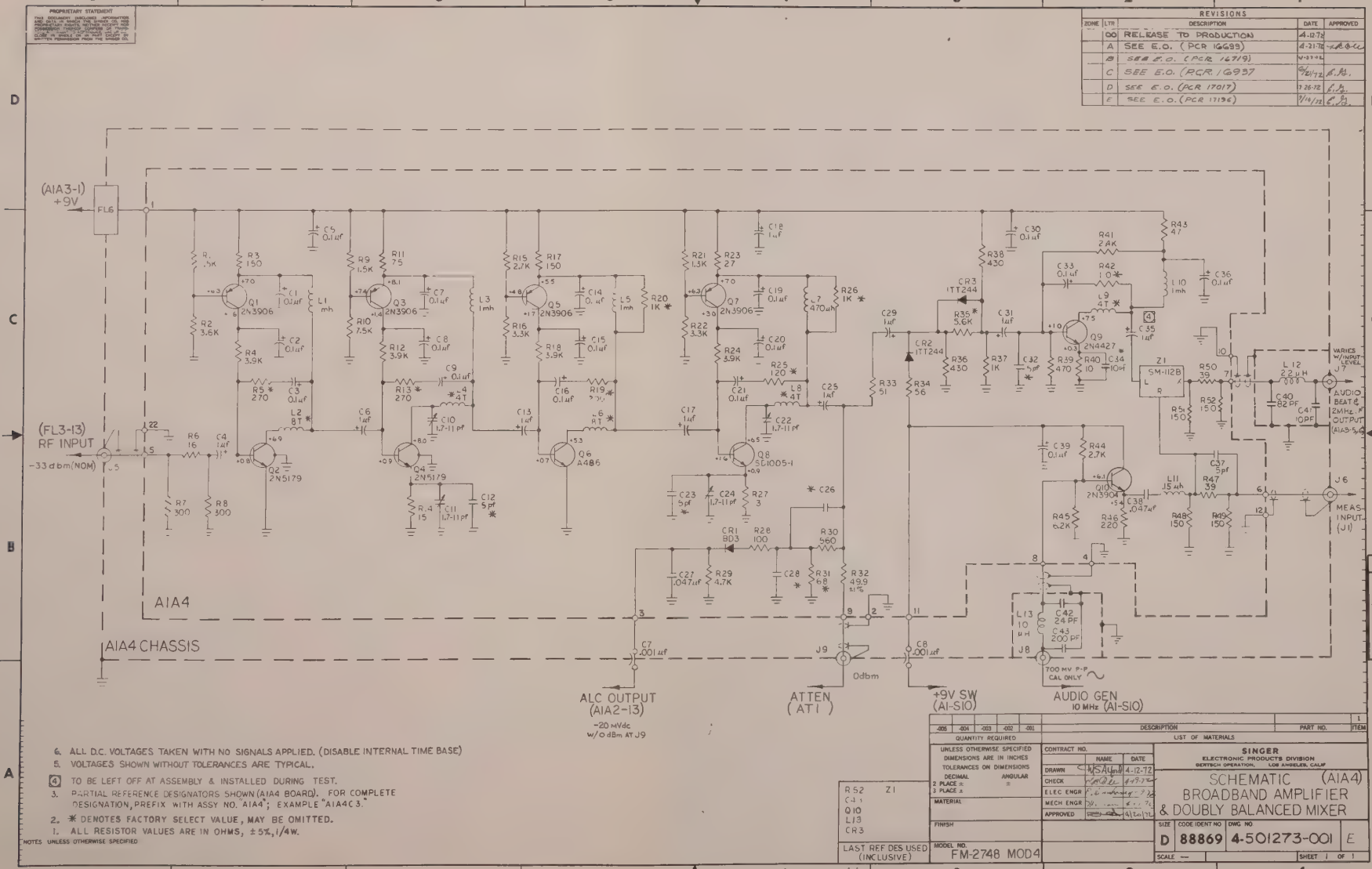


Figure 2-6. Broad Band Amplifier and Detector (A1A4), Schematic Diagram

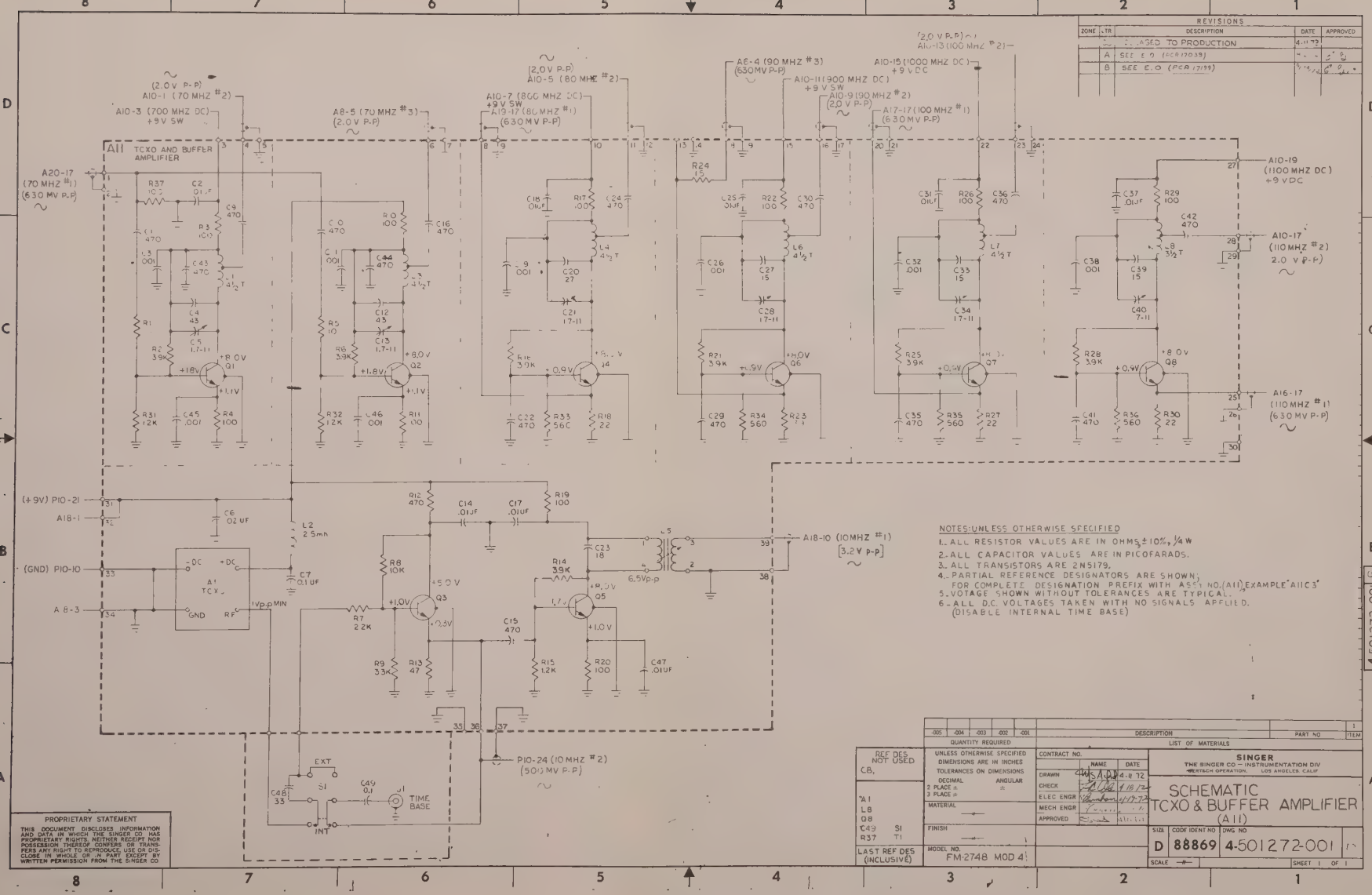


Figure 2-7. TCXO and Buffer Amplifier (A11), Schematic Diagram

SECTION III

FM-10 THEORY OF OPERATION

3.1 INTRODUCTION

This section covers the principles of operation of the Mainframe. The information is presented to assist the user in understanding the circuitry employed and is also useful in troubleshooting and maintenance of the equipment. The text is supported by the Typical Frequency Synthesis, Figure 3-1 and the Overall Functional Diagram, Figure 3-2.

3.2 LEFT HAND MODULE A1

Assembly A1 contains the input filter assembly; divider and automatic level control board A1A2, power supply, AF and IF amplifier board A1A3, broadband amplifier board A1A4, beat indicator, loudspeaker, and fixed and variable RF output attenuators.

3.3 RF OUTPUT CIRCUIT

The fully synthesized frequency provided by the synthesizer section of the Mainframe is supplied from low-pass filter FL3 on assembly A9 to broadband amplifier board A1A4 via pin 5. The amplifier output is supplied via variable attenuator AT2 to J2, the RF output connector.

3.4 BROADBAND AMPLIFIER (A1A4)

Broadband amplifier A1A4 receives the output of the Mainframe frequency synthesizer via pin 5. The synthesized frequency is amplified by Q1, Q2, and Q3 and appears at BNC connector J9.

3.5 MEASURE INPUT CIRCUIT

The input signal is supplied via front panel connector J1 (MEASURE INPUT) to a detector CR2 on assembly A1A4 which acts as a mixer. In CR2, the

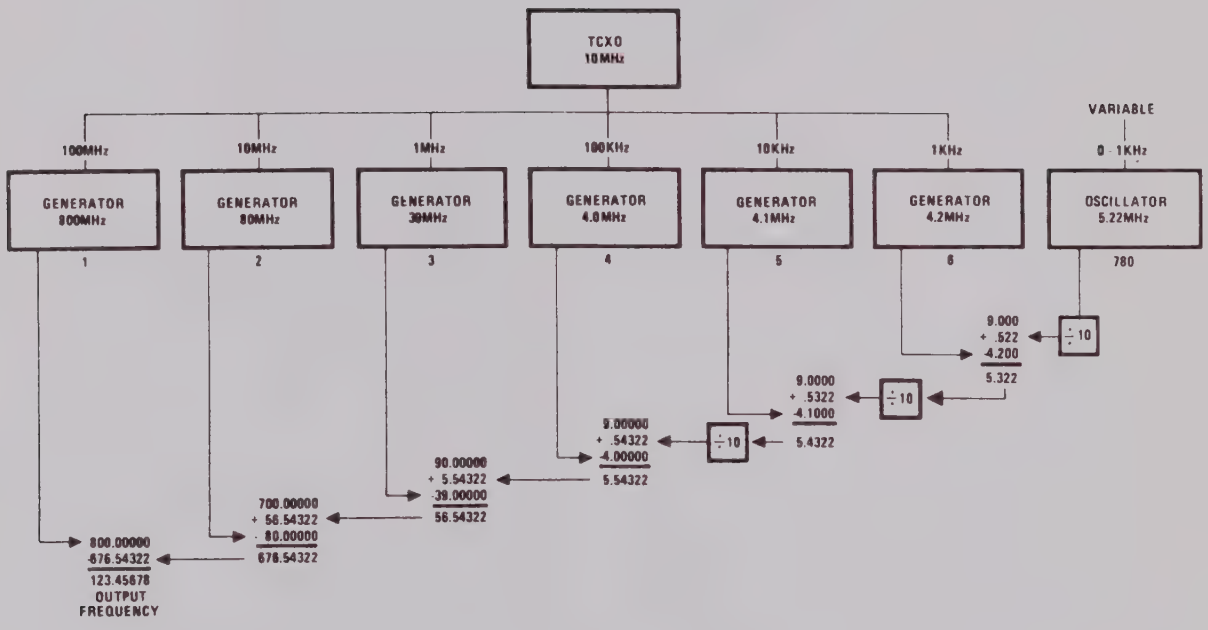


Figure 3-1. Typical Frequency Synthesis

input signal is mixed with the synthesized frequency generated by the Mainframe supplied from the broadband amplifier. From the mixer, the output is supplied via pin 7 on A1A4 to IF amplifier Q6 on A1A3. Output of the mixer may be an audio beat note or the 2-MHz IF signal carrying modulation which is supplied to the right-hand plug-in module (such as the MDM-1 or ODM-1) where it is demodulated. The audio output of A1A3Q6 is supplied to an audio preamplifier consisting of A1A3Q7 and Q8 and then via pin 10 to beat note selector switch S11. When S11 is in the BEAT (IN) position, the beat note appears at loudspeaker LS1 and the beat indicator following amplification by operational amplifier U7 on board A1A2. The output of U7 drives lamp driver Q9. The MOD (OUT) position of S11 switches the loudspeaker circuit to the demodulated audio output of any plug-in module which is inserted in the right-hand compartment.

3.6 AUTOMATIC LEVEL CONTROL

Automatic leveling of the output of the frequency synthesizer portion of the Mainframe is effected by detector CR1 on A1A4, the automatic level control amplifier on A1A2, and the gain control amplifier on A7. Detector CR1 supplies a dc voltage proportional to the amplitude of the output of broadband amplifier A1A4. The dc output is supplied to ALC amplifier on A1A2 via pin 13. This dc amplifier consists of U5, U6, and Q6. Transistors Q7 and Q8 and the voltage rectifier consisting of CR4 and CR5 take a 1-MHz signal supplied from Q4 and rectify it to provide negative dc voltage for use in the ALC circuit. This negative voltage appears at the junction of A1A2-R39 and A1A2-C27. According to the level of the synthesized output signal sensed by detector CR1 on assembly A1A4, the output signal produced by automatic level control amplifier on A1A2 at pin 15 is a dc voltage proportional to the carrier signal level. The output signal at pin 15 is routed to a gain control amplifier on assembly A7 via pin 1 and rear panel connector J10.

3.7 DIVIDER CIRCUIT (A1A2)

Three standard frequencies (100 kHz, 1 MHz, and 2 MHz) for use in other sections of the Mainframe are derived by the divider on A1A2 from a

10-MHz input signal (10-MHz No. 2) supplied from pin 24 of rear panel connector J10. This 10-MHz signal is supplied from the TCXO on A11.

> NOTE: This 10-MHz signal becomes the 10-MHz No. 3 signal which appears at pin 3 of A1A2. The 10-MHz No. 3 signal can be supplied as a substitute input signal to the measure input circuit for calibration purposes. It is selected by front panel switch S10.

The 10-MHz No. 2 is amplified by Q1 and Q2 and applied to IC U1. IC U1 contains a divide-by-five circuit and a divide-by-two circuit. The 10-MHz input is applied to the divide-by-five circuit to produce a 2-MHz output. This output is applied to the divide-by-two circuit and to Q5. The divide-by-two circuit halves the input to produce a 1-MHz output that is applied to IC U2 and to Q4. The 1-MHz and 2-MHz outputs of IC U1 are buffered by Q4 and Q5 respectively. IC U2 is identical to IC U1. The 1-MHz input is applied to the divide-by-five circuit, whose output is applied to the divide-by-two circuit, resulting in a total division of 10. The 100-kHz output of IC U2 is buffered by Q3.

3.8 POWER SUPPLY (A1A3)

The power supply comprises a 9-volt regulator consisting of Q3, Q4, and Q5 and a 12-volt regulator consisting of Q1. Transistor Q1 mounted on the rear of the left-hand module for heat sink purposes acts as a series-pass regulator.

3.9 VOLTAGE-CONTROLLED OSCILLATOR (VCO) BOARD A2

Voltage-controlled oscillator Q10, which provides the 0-1 kHz component of the final synthesized frequency, is controlled by a dc voltage derived from variable resistors R1 and R3, which constitute the front panel 0-1 KHz frequency control. The dc voltage varies the capacitance of Varicaps CR1 and CR2 that provide a tuning range of 5 to 6 MHz. From the oscillator circuit, the output signal is amplified by Q9 and Q8, and the amplified output signal appears at pin 5. The 5- to 6-MHz output of the VCO board is switched to the 100 KHz, 10 KHz, or 1 KHz frequency control when any of these frequency controls are at the V position.

When 0-1 KHz frequency control S7 is at the OUT position, the VCO is out of the circuit and the 6-MHz signal supplied from pin 9 of A2 is routed to the 1 KHz, 10 KHz, and 100 KHz frequency controls.

Another function of the VCO is to provide FM modulation. When a plug-in module that can supply an audio modulating tone is installed, the audio signal is supplied via pin 6 of A2 to the Varicaps to modulate the 5- to 6-MHz output signal of the VCO. The audio modulating signal at pin 6 comes from the plug-in via left-hand module rear connector J11. Modulation sensitivity is set by R47 and R44.

Also on VCO board A2 are two multiplier circuits that generate standard frequencies for use in other sections of the instrument.

The circuit consisting of Q1, Q2, Q3, and Q4 derives a 9-MHz signal from the 1-MHz input at pin 3 supplied via rear panel connector P10 from A1A2. Transistor Q1 is a shaper stage, while Q2, Q3, and Q4 are amplifiers tuned to the ninth harmonic of 1 MHz.

The circuit consisting of Q5, Q6, and Q7 derives a 6-MHz signal from the 2-MHz input appearing at pin A2-8 supplied via rear panel connector P10 from A1A2. Transistor Q5 is a multiplier stage tuned to the third harmonic of 2 MHz while Q6 and Q7 provide amplification.

3.10 1-kHz FREQUENCY CONTROL CIRCUIT A3

The 1 kHz frequency control circuit consists of decade divider U1, summing mixer U2, difference mixer U3, amplifiers Q1, Q5, and Q6, and buffer stages Q2, Q3, and Q4.

The input signal to divider U1 is either the 5- to 6-MHz output of the VCO circuit on A2 or the 6 MHz output of the X3 multiplier on A2 and is applied via amplifier Q1. The output of the divider, 0.5 to 0.6 MHz, is applied to summing mixer U2. Summing mixer U2 receives a second input of 9 MHz from A2 via buffer Q2. The output of the summing mixer is 9.5 to 9.6 MHz and is applied through a bandpass filter to difference mixer U3. Difference mixer U3 receives a second input of 3.6 to 4.5 MHz from switch S6 via buffer Q3, and a low pass filter. The 3.6- to 4.5-MHz signals are received from frequency generator boards A12 through A21. The output of difference

mixer U3 is 5 to 6 MHz. This output is buffered by Q4 and applied through bandpass filter FL1 to amplifiers Q5 and Q6. The output of the 1 kHz frequency control circuit varies from 5- to 6-MHz.

3.11 10-kHz FREQUENCY CONTROL CIRCUIT A4

The 10 kHz frequency control circuit is identical to 1 kHz frequency control circuit A3 except that the output of the 1 kHz frequency control circuit is one of the inputs to the 10 kHz frequency control circuit. The second and third inputs of 9 MHz and 3.6 to 4.5 MHz at pins 6 and 8 are also identical. The output of the 10 kHz frequency control circuit is 5 to 6 MHz.

3.12 100-kHz FREQUENCY CONTROL CIRCUIT A5

The 100-kHz frequency control circuit is also identical to the 1-kHz and the 10-kHz frequency control circuits, A3 and A4 respectively, except that one of its inputs is the output of the 10-kHz frequency control circuit A4. The output range of the 100-kHz frequency control circuit is 5 to 6 MHz.

3.13 1 MHz FREQUENCY CONTROL CIRCUIT A6

This is a mixer stage with three inputs and one output. The inputs are a 5- to 6-MHz signal at pin 6 from the 100-kHz frequency control circuit, a 90-MHz signal at pin 4 and a 36- to 45-MHz signal at pin 14. The output has a range of 50 to 60 MHz.

The 5- to 6-MHz input at pin 6 of A6 is applied to mixer U1. The other input to the mixer is the 90-MHz signal. The two inputs are summed, buffered by A1 and amplified by Q2, filtered by FL1, mixed with a 36- to 45-MHz input in difference mixer U2, giving an output range of 50- to 60-MHz. This is buffered by Q3, and amplified by Q4 and Q5, filtered by FL2, and supplied to pin 8 of A6.

3.14 10-MHz FREQUENCY CONTROL CIRCUIT A8

The 10-MHz frequency control circuit is a mixer stage with three inputs and one output. The inputs are 70 MHz at pin A8-5, 50 to 60 MHz at pin A8-3, and 60 to 150 MHz to mixer Z2 located on A8. The output is a

600- to 700-MHz signal from mixer Z2 that is applied to Gain Control Amplifier, A7.

The 50- to 60-MHz input at pin A8-3 is derived from 1-MHz frequency control circuit A6. This is applied to doubly balanced summing mixer Z1. The other input to Z1 is a 700-MHz signal derived from the 70-MHz input at pin A8-5. The 70-MHz signal is filtered by the LC network, applied to harmonic generation diodes CR1 and CR2, and amplified by Q1 which is tuned to the fifth harmonic. The output of Q1 is amplified by Q2 and applied to Q3, which is tuned to the second harmonic of its input, giving an overall multiplication of 10. Q4 is a buffer amplifier to drive mixer Z1. Thus, the output of summing mixer Z1 is 750 to 760 MHz that is amplified by Q7 and Q6 and filtered by filter FL1. The output of filter FL1 is applied to difference mixer Z2 together with the 60- to 150-MHz signal selected by the 10-MHz frequency control. The output of Z2 is a 600- to 700-MHz signal varying in 10-MHz steps. This is supplied to the gain control amplifier located on board A7.

3.15 GAIN CONTROL AMPLIFIER A7

The input to the gain control amplifier on A7 is derived from the 10-MHz frequency control on board A8 and consists of a signal in the range of 600 to 700 MHz. The signal is supplied to pin 4 and is amplified by Q8 and Q9, the gains of which are controlled by the signal appearing at pin 1 derived from the automatic level control amplifier on board A1A2. Then, the signal is applied to diode modulator CR1 and CR2 and passes through filter FL2 via pin 6. Consisting of CR1 and CR2, the diode modulator provides amplitude modulation of the signal when a modulating signal is supplied from a plug-in module via the rear panel connector J11. From assembly A7, the output signal is routed to filter Z1 on assembly A9.

3.16 DIODE SWITCH, MIXER, AND LOW PASS FILTER, A9

The 600 to 700 MHz output signal from filter FL2 on assembly A7 is supplied to doubly balanced difference mixer Z1 on assembly A9. Here it is mixed with a 700 to 1100 MHz signal selected by front panel switch S1

(100 MHz frequency control) which operates diode switch circuits consisting of CR1, CR2, CR3, CR4, and CR5. The application of +9 V dc via switch S1 causes one of the diodes to conduct, thus supplying a frequency in the range of 700- to 1100-MHz to mixer Z1. The products of mixing lie in the range of 0 to 500 MHz, but the output circuit of mixer Z1 is limited to the range of 50 kHz to 500 MHz. The output signal of the mixer is filtered by low pass filter FL3 and supplied to the broadband output amplifier on assembly A1A4 via connector A1A4-J5.

3.17 100-MHz FREQUENCY CONTROL CIRCUIT A10

Assembly A10 consists of five multiplier-amplifier chains which provide standard frequencies (700, 800, 900, 1000, and 1100 MHz) to diode switch circuits on assembly A9.

Input signals to the five chains consist of five frequencies: 70, 80, 90, 100 and 110 MHz. These are also standard frequencies derived from buffer amplifiers on assembly A11.

The 70-MHz input is supplied to pin 1 of A10 and passes through harmonic generators CR1 and CR2, and then to multiplier Q1 which is tuned to the fifth harmonic, 350 MHz. The signal is then amplified by buffer amplifier Q2 and doubled in frequency by multiplier Q3, tuned to 700 MHz. Further amplification is provided by Q4.

The 80, 90, 100 and 110 MHz signals are all multiplied in identical fashion in the remaining four chains on assembly A10.

3.18 TCXO AND BUFFER AMPLIFIER A11

The buffer assemblies consist of Q1, Q2, Q4, Q6, Q7, and Q8. Input signals to these stages consist of frequencies 70, 80, 90, 100 and 110 MHz. These are derived from frequency generation assemblies A16 to A20. Output signals from Q1, Q4, Q6, Q7, and Q8 are supplied to multipliers on assembly A10. The 70-MHz output of buffer Q2 is supplied to the 10 MHz frequency control on assembly A8.

The other section of assembly A11 contains subassembly A11A1, the 10-MHz TCXO crystal that is the prime frequency standard from which all others in the Mainframe are derived. Transistors Q3 and Q5 provide

two amplified 10-MHz outputs at pins 36 and 39. One output is supplied to assembly A18 and the other to the left-hand module A1 via rear panel connector J10.

3.19 FREQUENCY GENERATOR ASSEMBLY (4.5, 45, and 150 MHz) A12

Assembly A12 generates frequencies of 4.5, 45, and 150 MHz for use in three separate sections of the Mainframe. There are two standard frequency input signals of 100 kHz and 10 MHz. Output frequencies of 4.5 and 45 MHz are derived by a successive multiplication from the 100-kHz signal. The 150-MHz output is derived from the 10-MHz input by means of a $\times 15$ multiplier.

The 100-kHz input signal to assembly A12 is generated on assembly A1A2 by divider circuitry. The 100-kHz output of A1A2 is supplied to assemblies A12 through A21 by a direct line to assembly A18 and then by crosspatching to the other assemblies.

The 100-kHz signal is supplied to multiplier Q1, which is tuned to the forty-fifth harmonic 4.5 MHz. Transistor Q2 and crystal Y2 form a 4.5-MHz filter. Integrated circuit U1 provides amplification and limiting, and emitter follower Q8 provides isolation. The output of 4.5 MHz appears at pin 23. A further 4.5-MHz output is taken from U1 at the junctions of pins 11, 12, and 14 and supplied, via crystal Y1, to shaping circuit Q3 and to multiplier Q4 tuned to the tenth harmonic of 4.5 MHz. Transistor Q7 is a tuned amplifier. The 45 MHz output appears at pin 20.

The third multiplier on assembly A12 derives the 150-MHz output from the 10-MHz input appearing at pin 9. The 10-MHz signal is shaped by transistor Q5 and multiplied by Q6, which is tuned to the fifteenth harmonic 150 MHz. Transistor Q10 and Q11 provide amplification and filtering.

3.20 FREQUENCY GENERATOR ASSEMBLIES A13 to A21

Assemblies A13 to A21 are identical to assembly A12 except for the frequencies generated.

Frequencies generated include:

A13	4.4, 44, and 140 MHz
A14	4.3, 43, and 130 MHz
A15	4.2, 42, and 120 MHz
A16	4.1, 41, and 110 MHz
A17	4.0, 40, and 100 MHz
A18	3.9, 39, and 90 MHz
A19	3.8, 38, and 80 MHz
A20	3.7, 37, and 70 MHz
A21	3.6, 36, and 60 MHz

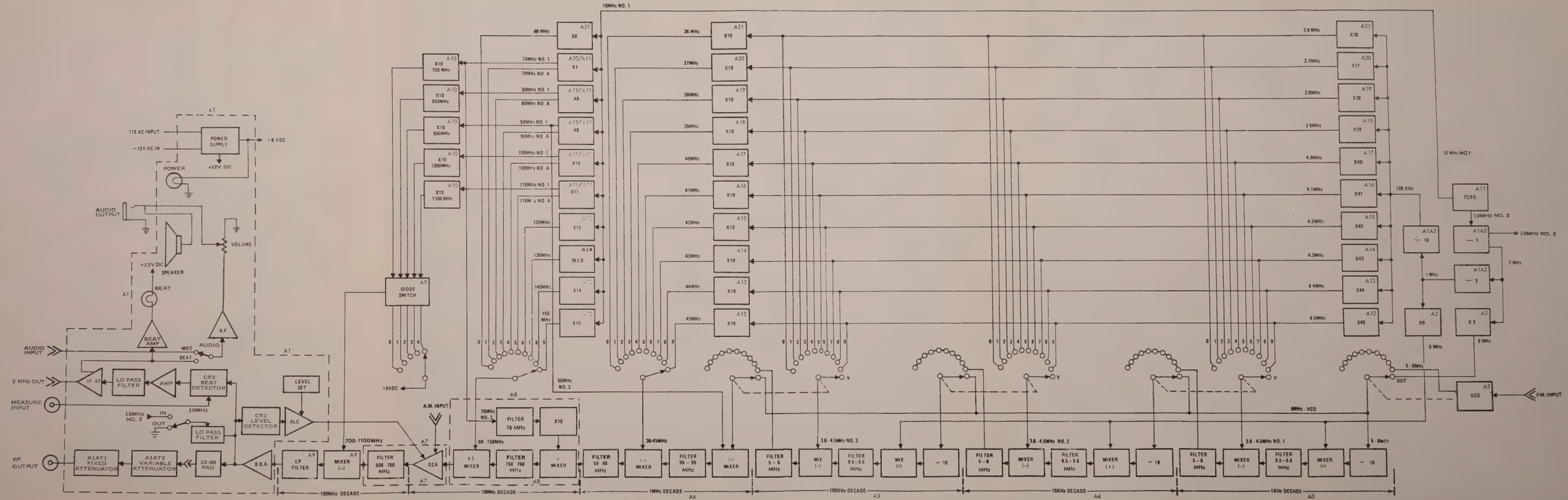


Figure 3-2. Overall Functional Diagram

SECTION IV

FM-10 MAINTENANCE

4.1 INTRODUCTION

This section contains general maintenance, troubleshooting, and alignment information.

> NOTE: Throughout this section, the term 'CRT' denotes the oscilloscope presentation on a plug-in-module. The word 'Oscilloscope' refers to an external test equipment (Tektronix Model 454 or equivalent).

There are instances in this section where an Oscilloscope with a vertical bandwidth greater than 40 MHz is specified. However, the listed Frequency Counter and RF Voltmeter, used together, may be substituted in some instances. An example of where the substitution may be made is paragraph 4.5.8.b, c, and e. The listed high impedance probe should be used with the RF Voltmeter for these readings. However, in paragraph 4.5.8 d, and f, which call for measurements of the outputs of summing Mixer U1 and difference Mixer U2, both the sum and difference mixed frequencies are present plus the fundamental frequency. The presence of these three frequencies will give erroneous readings on the RF Voltmeter and Frequency Counter.

All DC voltages shown without tolerances on the schematic diagrams in Section V are typical. These voltages may vary widely (+100%, -50%) from unit to unit due to component tolerances and wide beta ranges of the transistors. This does not imply that unit(s), in which measured voltages are at or near the tolerance extremes will not perform to the specifications, since the unit has been designed to make allowances for these tolerances.

All AC(including RF) voltages shown without tolerances on the schematic diagrams in Section V are typical. These voltages may vary widely (±6 dB) from unit to unit due to component specifications and tolerances, and wide beta ranges of the transistors. This does not imply that unit(s), in which measured voltages are at or near the tolerance extremes will not perform to the specifications, since the unit has been designed to make allowances for these tolerances.

4.2 GENERAL MAINTENANCE INFORMATION

4.2.1 BASIC REQUIREMENTS. Each Mainframe is carefully checked at the factory and no further internal adjustments are required prior to placing the equipment in operation. In the event of failure or malfunction, troubleshooting or adjustments should be attempted only if proper test equipment is available and only by qualified technicians.

4.2.2 TEST EQUIPMENT. The test equipment required for checkout, alignment, calibration, and troubleshooting is tabulated in Table 4-1. Use the recommended type or equivalent.

4.3 POWER REQUIREMENTS.

40 VA Maximum for 115/230 Vac operation (without plug-in)

2 A Maximum for 11.5 to 15.0 Vdc operation (without plug-in)

> WARNING
>
> High voltages are present throughout the unit and appropriate precautions should be taken while operating the unit with cover removed.

4.4 MINIMUM PERFORMANCE CHECKOUT PROCEDURE

4.4.1 START PROCEDURE.

a. Connect power source to mainframe.
b. For dc power, press PWR switch to OUT/DC position.
c. For ac power, press PWR switch to IN/AC position.
d. Verify that PWR indicator lamp comes on.

4.4.2 TONE GENERATOR MODE.

a. Set Mainframe controls as follows:

10 MHz switch	IN
VOLUME	Fully CW
Frequency Controls	010.0000
AUDIO	IN/BEAT
TIMEBASE (Rear of unit)	INT

TABLE 4-1. TEST EQUIPMENT REQUIREMENTS

TYPE	MINIMUM PARAMETERS	RECOMMENDED MODEL
Audio Oscillator	Frequency range: 1 kHz	Hewlett-Packard, Model 651
Signal Generator	Output: adjustable from 0 V rms to 2 V rms	
Signal Generator	Stability: Better than ±0004%/5 min	Singer Model FM-2748
	Frequency range: 1 MHz to 250 MHz	
	Leveling: ±1 db	
	Output: adjustable from 0.2 mV rms to 90 mV rms	
	Output Impedance: 50Ω nominal	
Oscilloscope	Frequency Response: 100 MHz	Tektronix, Model 454
	Sensitivity: 5 mV/cm to 10 V/cm	
Frequency Counter	Frequency range: 50 kHz to 500 MHz, 10 mV rms sensitivity, 1 x 10-7 accuracy	Hewlett-Packard, Model 5245L
AC VTVM	Frequency response: 50 Hz to 2 MHz	Hewlett Packard, Model 400D
	Range: measure in the area of 2 to 400 mV rms	
DC Digital Voltmeter or VTVM	Range: 10 mV to 30 V dc	Hewlett-Packard, Model 412A
	Accuracy: ±1%	
RF Voltmeter	Frequency range: 50 kHz to 1100 MHz	Booton 91-D/E series with 50 ohm load and high impedance probe
	Voltage range; 500 μV rms to 1 V rms	
Spectrum Analyzer	Frequency range: 10 MHz to 1.2 GHz	Singer, Model SPA-3000
	Dispersion: 10 kHz/division to 100 MHz/division	
	Dynamic range: 60 db minimum	
	Maximum Level Measured: +10 dbm	

TABLE 4-1. TEST EQUIPMENT REQUIREMENTS

TYPE	MINIMUM PARAMETERS	RECOMMENDED MODEL
Sweep Generator	Frequency range: 500-800 MHz Output: 0 dbm to -20 dbm	Wavetek Model 2001
RF Detector	Frequency range: DC -800 MHz	Wavetek Model D152
DC Power Supply	Output: 0 V to 5 V at 10 mA Regulation: ±5%	Hewlett-Packard, Model 721A
Speaker/Headset	Impedance: 45 Ω/2000 Ω	As Available
Oscilloscope Deviation Monitor	Mainframe must be tested with this associated plug-in module.	Singer, Model ODM-1
Oscilloscope Amplitude Modulation Monitor	Mainframe must be tested with this associated plug-in module.	Singer, Model OAM-1
AFM-2	Mainframe must be tested with this associated plug-in module.	Singer, Model AFM-2
Broadband Amplifier	Gain: 20 db minimum from 50 kHz to 500 MHz.	Singer, Model BBA-1
FM-10 Extender Cables	NA	Singer, PC 2652 (for RH module) and PC2653 (for LH module)

b. Adjust 0-1 KHz frequency control for a BEAT lamp indication of approximately 1 flash per second.

c. Set VOLUME control at desired level and adjust 0-1 KHz frequency control throughout its range. A 0-1 kHz tone should be audible from the internal speaker.

d. Turn 1 KHz frequency control from 0 position to 9 position. Tone frequency should increase at each control position.

e. Plug a 45 Ω speaker or 2000 Ω headset into AUDIO OUTPUT jack. Repeat step d. Tone frequency from remote Speaker/Headset should increase at each control position.

4.4.3 FREQUENCY ACCURACY.

a. Connect Broadband Amplifier input to Mainframe RF OUTPUT jack with a 50 Ω coaxial cable.

b. Connect Broadband Amplifier output to Frequency Counter input jack.

c. Push 10 MHz switch to OUT position and AUDIO switch to OUT/MOD position.

d. Set RF OUTPUT control at maximum CW position.

e. Set frequency controls at 100.000 MHz and 0-1 KHz frequency control at OUT position.

f. Frequency Counter should indicate 100.000 MHz ± 1ppm.

g. Set 100 MHz frequency control at 2, 3, and 4 while verifying frequency accuracy.

h. Reset 100 MHz frequency control at 1.

j. Set 10 MHz frequency control at 1, 2, 3, 4, 5, 6, 7, 8, and 9 while verifying frequency accuracy.

k. Set 100 MHz frequency control at 0 and 10 MHz frequency control at 1 and verify frequency accuracy.

l. Check all positions of 100 KHz, 10 KHz and 1 KHz frequency control verifying frequency accuracy.

m. Set frequency controls at 001.000 MHz and rotate 0-1 KHz frequency control throughout its range. Verify that frequency is within ±50 Hz of frequency control reading.

4.4.4 OUTPUT LEVEL CHECK.

a. Connect RF Voltmeter to RF OUTPUT jack.

b. Set RF OUTPUT level at 5 μV.

c. Set frequency controls at 100.000 MHz and 0-1 KHz frequency control at OUT position.

d. Verify that RF Voltmeter indicates 500 μV ±3 db.

e. Repeat for all frequencies in steps g through m of paragraph 4.4.3. Verify that all levels are 500 μV ±3 db.

4.4.5 AMPLITUDE MODULATION CHECK.

4.4.5.1 Cal Level.

a. Plug OAM-1 into right-hand compartment.

b. Press 10 MHz switch to IN.

c. Set frequency controls at 8.000 MHz. Allow 2 minutes warm-up time.

d. Set VERT MODE switch at VERT SET.

e. Position CRT trace on VERTICAL SET line of graticule with VERT POS control.

f. Set VERT MODE switch at CARR SET.

g. Position CRT trace on CARRIER SET line of graticule with CARRIER LEVEL control.

4.4.5.2 Sensitivity.

a. Set RANGE switch at GEN 30%.

b. Set MOD/AUDIO OUT FREQ switch at 1 kHz.

c. Rotate INT MOD/AUDIO OUT control fully CW.

d. Set VERT MODE switch at MEAS AM.

e. Verify that recovered audio on CRT is greater than full-scale deflection.

4.4.5.3 Distortion.

a. Rotate INT MOD/AUDIO OUT control for exact full-scale deflection.

b. Connect Distortion Analyzer to DIST ANAL jack and calibrate it to modulating frequency.

c. Verify that measured distortion is less than 3% at 30% modulation.

4.4.6 FREQUENCY MODULATION CHECK.

a. Install ODM-1 in right hand compartment.

b. Set Mainframe at 8 MHz, 10 KHz frequency control at V, 0-1 KHz frequency control at 0, and press 10 MHz switch to IN.

c. Set ODM controls as follows:

INT MOD/AUDIO OUT	Fully CCW (not off).
VERT IN	INT
DEV RANGE	5 kHz
MOD MODE	INT/COMB

d. Set INTENSITY and FOCUS controls for sharpest trace. Center trace on CRT with VERT CENTER control.

e. Verify that OPER indicator lamp is on.

f. Adjust INT MOD/AUDIO OUT control fully CW and verify that CRT trace is greater than full screen.

g. Set Mainframe 10 KHz frequency control at 0 and 100 KHz frequency control at V.

h. Set DEV RANGE switch at 15 kHz. Verify that CRT trace is greater than full scale.

4.4.7 MEASURE INPUT SENSITIVITY.

a. Set Mainframe at 151 MHz and 0-1 KHz frequency control at OUT.

b. Connect Signal Generator to Mainframe MEASURE INPUT and set Signal Generator for an output of 151 MHz at 6 mV (-31 dbm).

c. Tune Signal Generator until Mainframe indicates zero beat.

d. Set Mainframe at 153 MHz and set AUDIO switch at OUT/MOD. Verify that OPER indicator comes on with Signal Generator output of 6 mV (-31 dbm ±3 db).

e. Increase Signal Generator output 20 db and verify that OVLD indicator comes on [60 mV (-11 dbm ±3 db)] .

4.5 ALIGNMENT AND ADJUSTMENT

> WARNING
>
> High voltages are present throughout the unit, and appropriate precautions should be taken while operating the unit with the cover removed.

All circuit boards except A1A2, A1A3, A1A4, A7/A8, and A9/A10 are removed from their mountings by sliding them out sideways (see Figures 4-1 and 6-1 for

board locations). Most adjustments are made with each board only half-way out of its compartment. When reinserting boards, dress all wires carefully. Note that some boards cannot be reinserted unless wires are fully dressed toward appropriate ends of their compartments.

Adjustments to boards in Left-Hand Module (A1) are made with module partially withdrawn from Mainframe on extender cable. Adjustments to A7/A8 assembly are made by removing mounting screws and lifting assembly out. All internal adjustments described in paragraphs 4.5.1 through 4.5.32 should not be performed until board input levels and +9 V dc voltage are verified.

Calibration of the TCXO (paragraph 4.5.33) and adjustment of 0-1 KHz frequency control may be carried out separately.

4.5.1 BOARD A1A3 ADJUSTMENT (FIGURE 4-2).

a. Connect DC VTVM and Oscilloscope between pin 1 and chassis ground.

b. Adjust R10 for +9 V dc ±0.09 V on VTVM and verify that output ripple is less than 2.7 mV p-p.

c. Connect DC VTVM to TP-1. Verify that voltage is +12 V dc ±10%.

d. Set Mainframe frequency controls at 10 MHz, 0-1 KHz frequency control at OUT, press 10 MHz switch to OUT, and press AUDIO switch to IN/BEAT.

e. Install an AFM-2 in Mainframe, and connect AC VTVM to 2 MHz IF jack with a 200-ohm resistor across VTVM input terminals.

f. Connect Signal Generator to Mainframe MEASURE INPUT jack, with its frequency set at 10 MHz and level at 6 mV rms.

g. Adjust Signal Generator frequency slightly for a zero beat indication.

h. Set Mainframe at 12 MHz. Adjust A1A3-L1 for maximum output on VTVM. Adjust A1A3-R30 for exactly 2.5 mV rms on VTVM. Peak L1 and readjust R30 as necessary to obtain exactly 2.5 mV rms on VTVM.

j. Disconnect Signal Generator from MEASURE INPUT jack, set Mainframe frequency at 10 MHz, press 10 MHz to IN, set 1 KHz frequency control at 1, and rotate VOLUME control fully CW.

k. Note that a loud 1-kHz tone is audible from speaker.

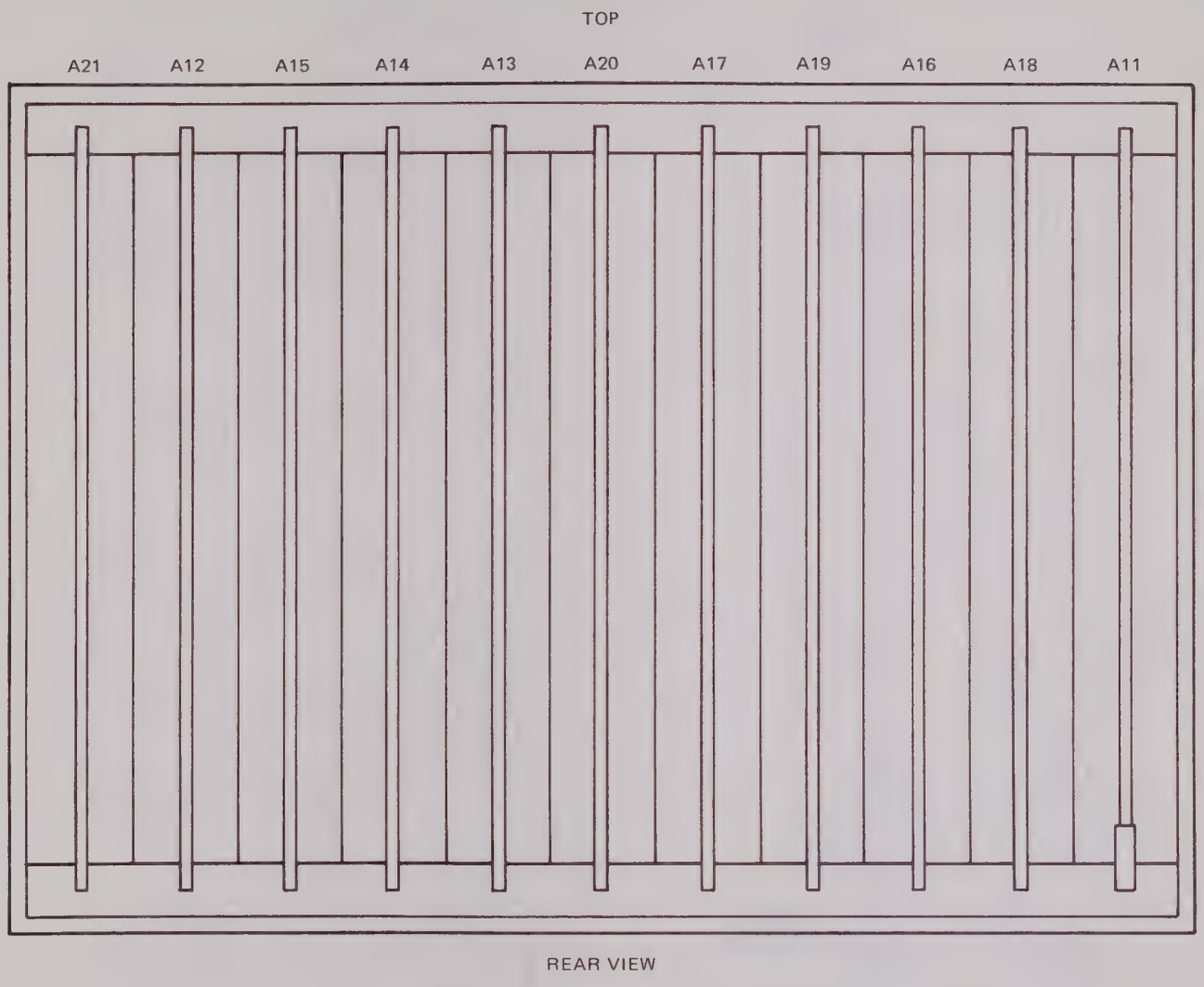


Figure 4-1. A11-A21 Board Locations

4.5.2 BOARD A1A2 ADJUSTMENTS (FIGURE 4-3).

a. Set Mainframe frequency at 10.001 MHz, press AUDIO switch to IN/BEAT, and press 10 MHz switch to IN.

b. Connect Oscilloscope to pin 5. Verify that 10 MHz level is approximately 500 mV p-p.

c. Connect Oscilloscope to pin 3. Verify that 10 MHz level is approximately 3 V p-p.

d. Connect Oscilloscope to pin 7. Verify that 100 kHz spike is approximately 1.5 V p-p.

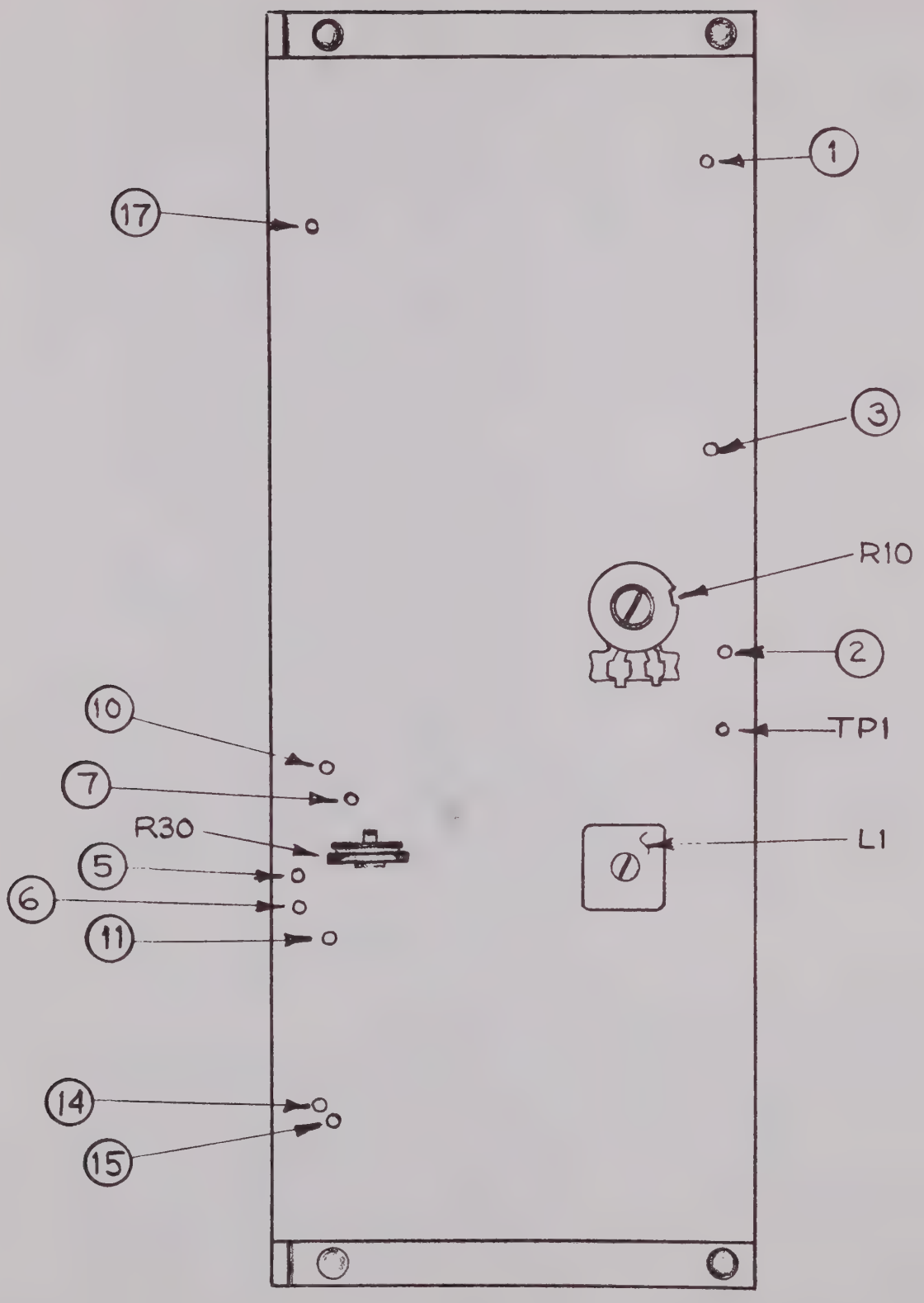


Figure 4-2. A1A3 Board, Location Diagram

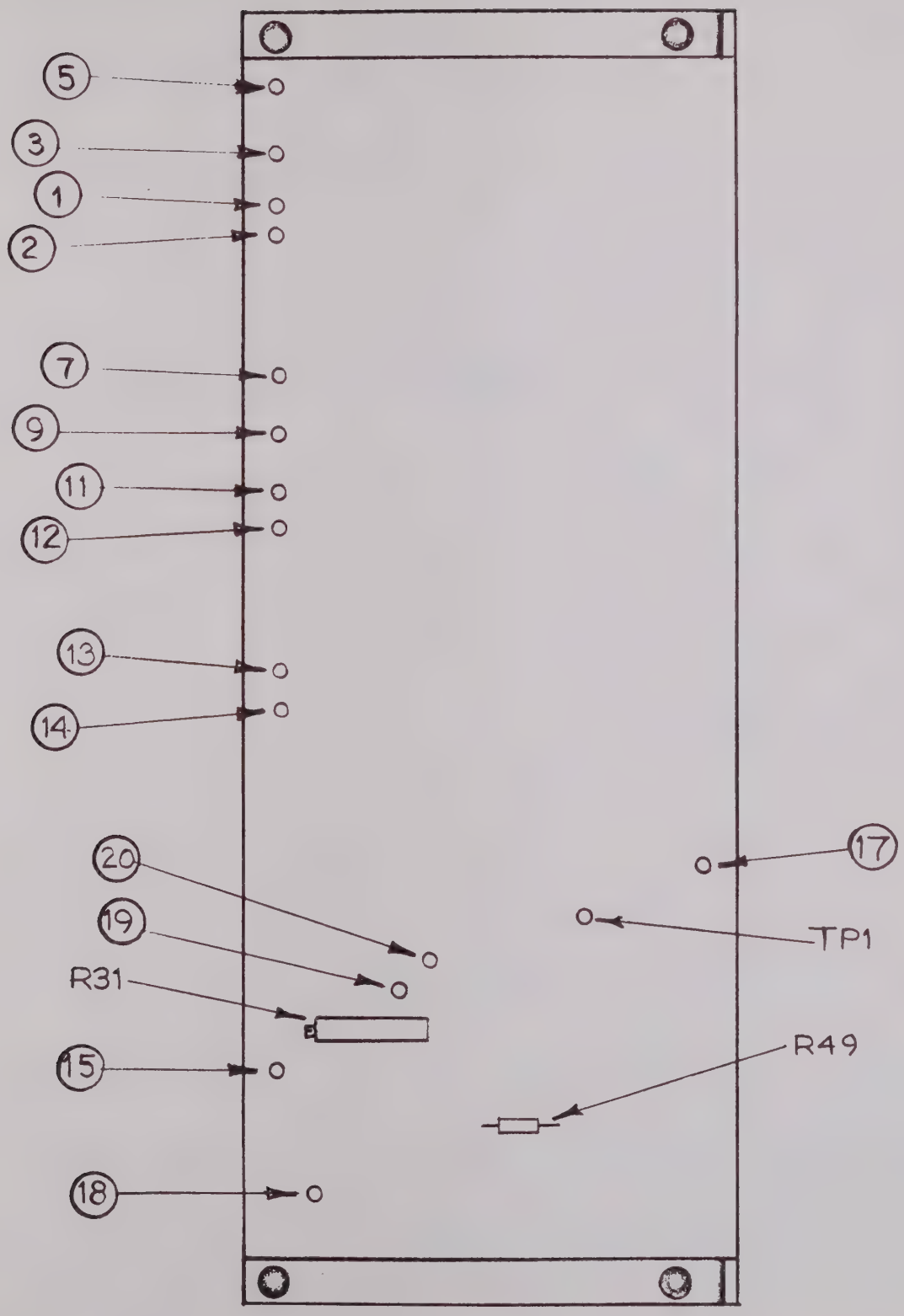


Figure 4-3. A1A2 Board, Location Diagram

e. Connect Oscilloscope to pin 9. Verify that 1 MHz squarewave is approximately 2.5 V p-p.

f. Connect Oscilloscope to pin 11. Verify that 2 MHz squarewave is approximately 3 V p-p.

g. Connect Oscilloscope to pin 17. Voltage should be not less than 50 mV p-p.

h. Verify that BEAT indicator is now lit.

j. If BEAT indicator is not lit, connect Signal Generator to MEASURE INPUT jack and set its frequency at 10 MHz and level at 6 mV rms.

k. Set Mainframe frequency at 10 MHz and press 10 MHz switch to OUT. Adjust Signal Generator frequency for a zero beat indication from speaker and set 10 KHz frequency control at 5.

l. Adjust value of R49 until BEAT indicator just comes on.

m. Connect DC VTVM to TP-1. Verify that voltage is approximately -6.8 V dc.

n. Disconnect Signal Generator and set Mainframe frequency at 250 MHz, press AUDIO and 10 MHz switches to OUT.

p. Disconnect variable attenuator AT-2 from A1J9 jack and connect RF Voltmeter with 50-ohm termination to A1J9.

q. Adjust A1A2-R31 for an RF Voltmeter indication of -23 dbm.

r. Connect DC VTVM to pin 15. Verify that voltage is between +2 V and +3.1 V.

4.5.3 BOARD A1A4 CHECKOUT (FIGURE 4-4).

a. Connect Signal Generator to Mainframe MEASURE INPUT jack. Set frequency at 10 MHz and level at 6 mV rms (-31 dbm).

b. Set Mainframe frequency at 10 MHz, press 10 MHz switch to OUT, and press AUDIO switch to IN/BEAT.

c. Install an AFM-2 in Mainframe, Connect AC VTVM to 2 MHz IF jack on the AFM-2 with a 200-ohm resistor across VTVM terminals.

d. Adjust Signal Generator frequency slightly for a zero beat indication. Set Mainframe frequency at 8 MHz. Verify that VTVM indicates 2.5 mV rms ±10%.

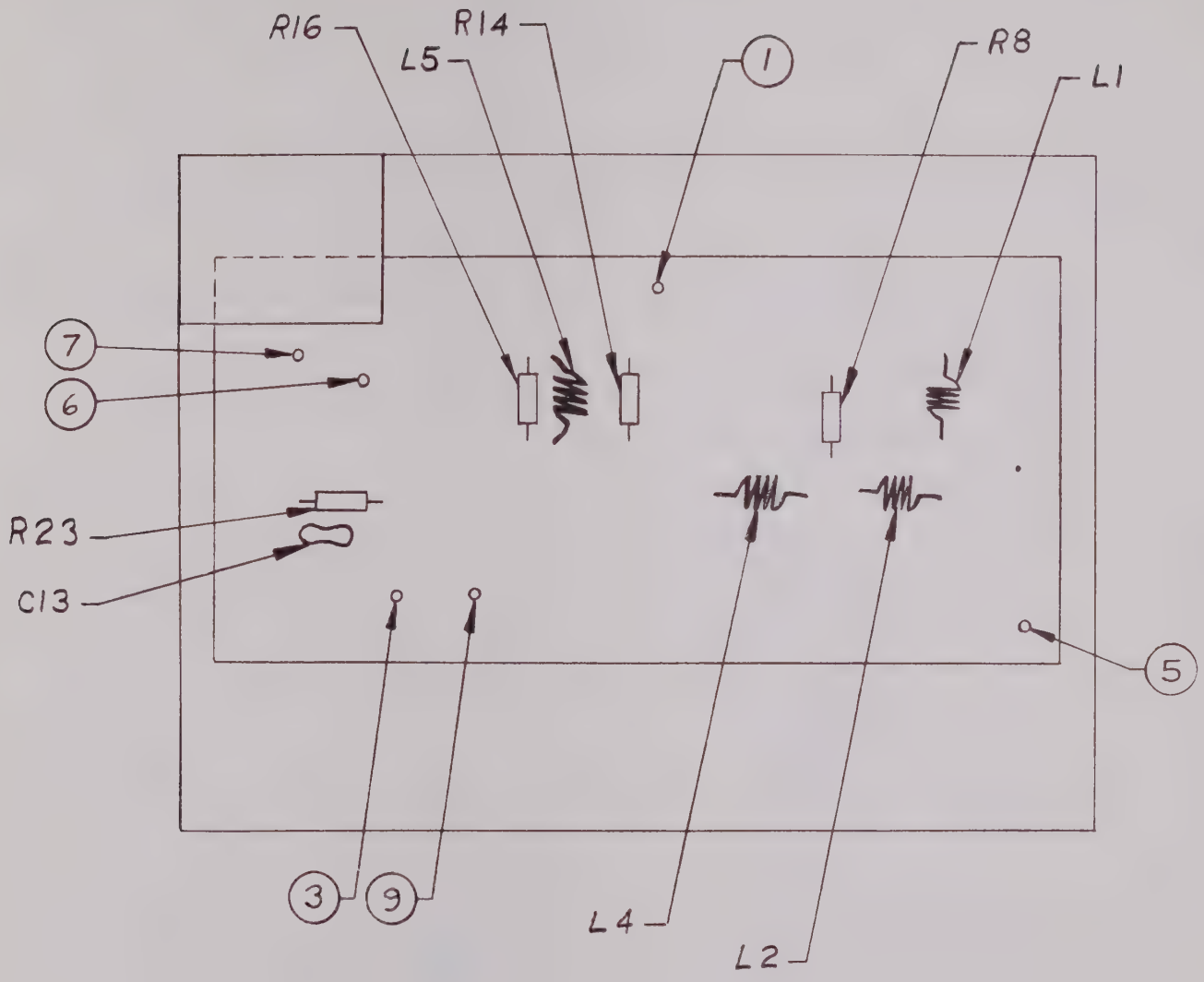


Figure 4-4. A1A4 Assembly, Location Diagram

e. Set Mainframe and Signal Generator frequencies at 1 MHz. Disconnect variable attenuator cable from A1J9 and connect RF Voltmeter, with 50-ohm termination, to A1J9. Verify that level is -23 dbm ±1 db.

f. Set Mainframe and Signal Generator frequencies at 50 MHz and obtain a zero beat indication. Verify that level is -23 dbm ± 1 db.

g. Repeat step f. at 100, 150, 200, 250, 300, 350, 400, 450, and 500 MHz. Level should be -23 dbm ± 1 db between 1 MHz and 500 MHz.

h. Disconnect Signal Generator. Set Mainframe frequency at 8 MHz, press 10 MHz switch to IN, and press AUDIO switch to OUT/MOD.

j. Verify that 2 MHz IF level indication on VTVM is 4.2 mV rms ±20%.

4.5.4 BOARD A2 ADJUSTMENT (FIGURE 4-5).

a. Set Mainframe frequency controls at 0 and 0-1 KHz frequency control at OUT.

b. Lift board A2 and connect Oscilloscope to pin 3 (1 MHz input) and ground. Voltage should be approximately 2.5 V p-p squarewave.

c. Connect Oscilloscope to pin 8 (2 MHz input) and ground. Voltage should be approximately 3.0 V p-p squarewave.

d. Connect Oscilloscope to pin 7 (9 MHz output) and ground. Adjust L1, L2, and L3 for maximum output of approximately 500 mV p-p.

e. Connect Oscilloscope to pin 9 (6 MHz output) and ground. Adjust L4 for maximum output of approximately 2.2 to 6.0 V p-p.

f. Connect Broadband Amplifier input to Mainframe RF OUTPUT and output to Frequency Counter input.

g. Set Mainframe at 001.000, and 0-1 KHz frequency control at 0, and adjust L5 for exactly 1 MHz on Frequency Counter.

h. Connect Oscilloscope to pin 5 (VCO 5-6 MHz output). Voltage should be approximately 2.2 V p-p. If less than 2.2 V p-p, select R25 until Oscilloscope indicates 2.2 V +10% -0. If it is necessary to change the value of R25, repeat step g. and continue with procedure.

j. Set Mainframe 0-1 KHz frequency control at 5 and adjust R30 for exactly 1,000,500 Hz on frequency counter.

k. Set Mainframe 0-1 KHz frequency control at 10 and adjust R31 for exactly 1,001,000 Hz on Frequency Counter.

l. Repeat steps g, j, and k until frequencies are within ±10 Hz of 0-1 KHz frequency control setting.

m. Install ODM-1 in Mainframe.

n. Set Mainframe frequency controls at 008.0V0, 0-1 KHz frequency control at 0, press 10 MHz switch to IN, and press AUDIO switch to IN/BEAT.

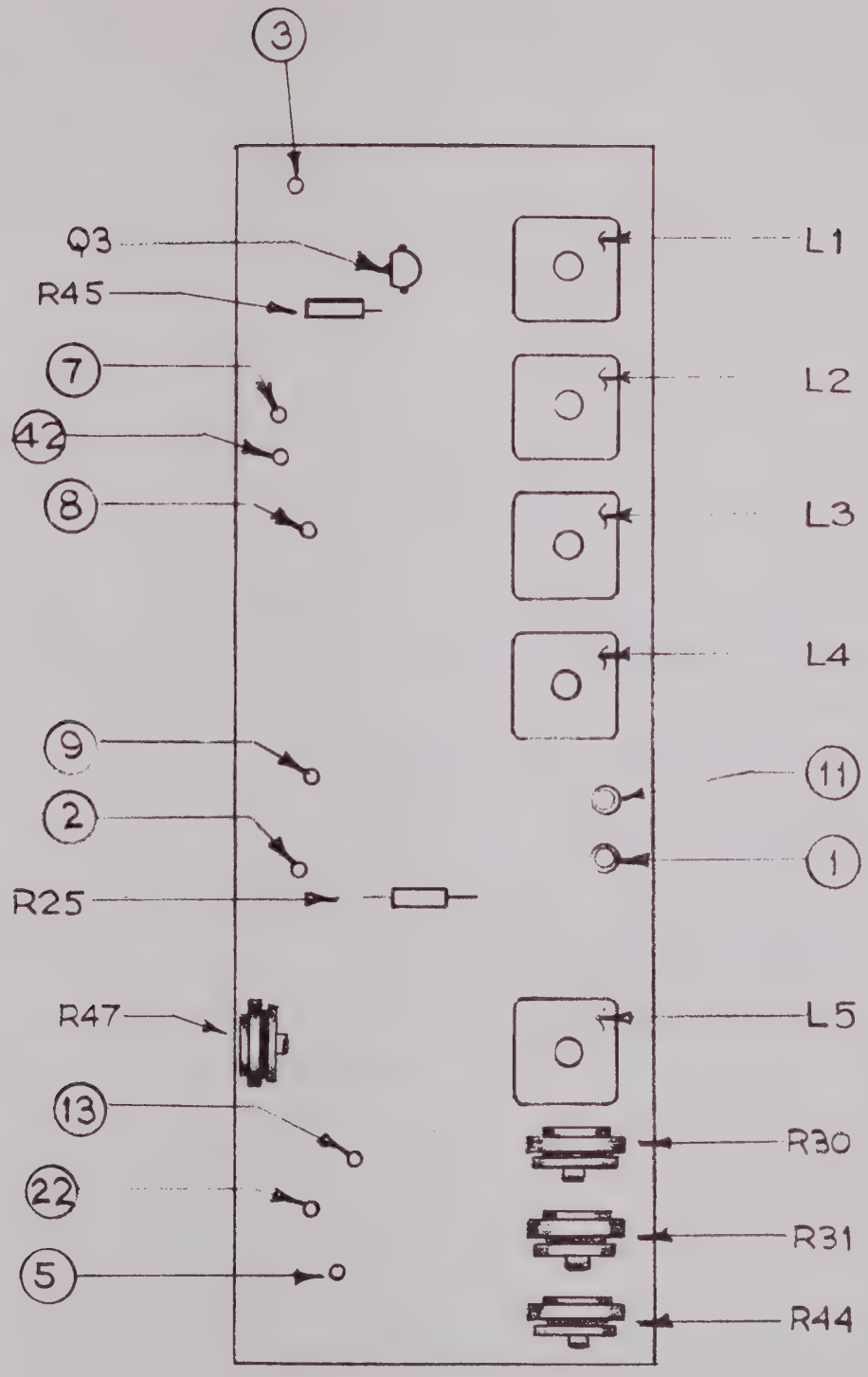


Figure 4-5. A2 Board, Location Diagram

p. Set ODM-1 controls as follows:

DEV RANGE	5 kHz
VERT IN	INT
MOD MODE	INT COMB
VERT CENTER	For trace on 0 center line of graticule

q. Connect AC VTVM to A2 pin 6.

r. Adjust ODM-1 INT MOD/AUDIO OUT control to obtain 500 mV rms on AC VTVM.

s. Adjust A2R47 to obtain exactly 5 kHz deviation on ODM-1 CRT graticule.

t. Set Mainframe frequency controls at 007.9V9 and 0-1 KHz frequency control at 10.

u. Adjust A2R44 to obtain exactly 5 kHz deviation on ODM-1 CRT graticule.

v. Repeat steps n, s, and u. due to interaction between trimmer resistors A2R47 and A2R44.

4.5.5 BOARD A3 ADJUSTMENT (FIGURE 4-6).

a. Lift board A3 and connect Oscilloscope to pin 3 (5-6 MHz input) and ground. Voltage should be approximately 2.2 to 6.0 V p-p.

b. Connect Oscilloscope to pin 6 (9 MHz input) and ground. Voltage should be approximately 500 mV p-p.

c. Connect Oscilloscope to pin 8 (3.6 to 4.5 MHz input) and ground. Voltage should be a sawtooth waveform of approximately 700 mV p-p.

d. Measure voltage at TP1 (500-600 kHz output). Voltage should be approximately 600 mV p-p.

e. Connect oscilloscope to TP-2 and set Mainframe 0-1 KHz frequency control at 5.

f. Adjust L1 and L2 for maximum voltage and purest sine wave (9.55 MHz). Voltage should be approximately 130 mV p-p.

g. If voltage at TP-2 is less than 130 mV p-p, increase value of C11 to obtain 130 mV p-p.

h. Connect oscilloscope to TP-3 and set Mainframe 1 KHz frequency control at 4.

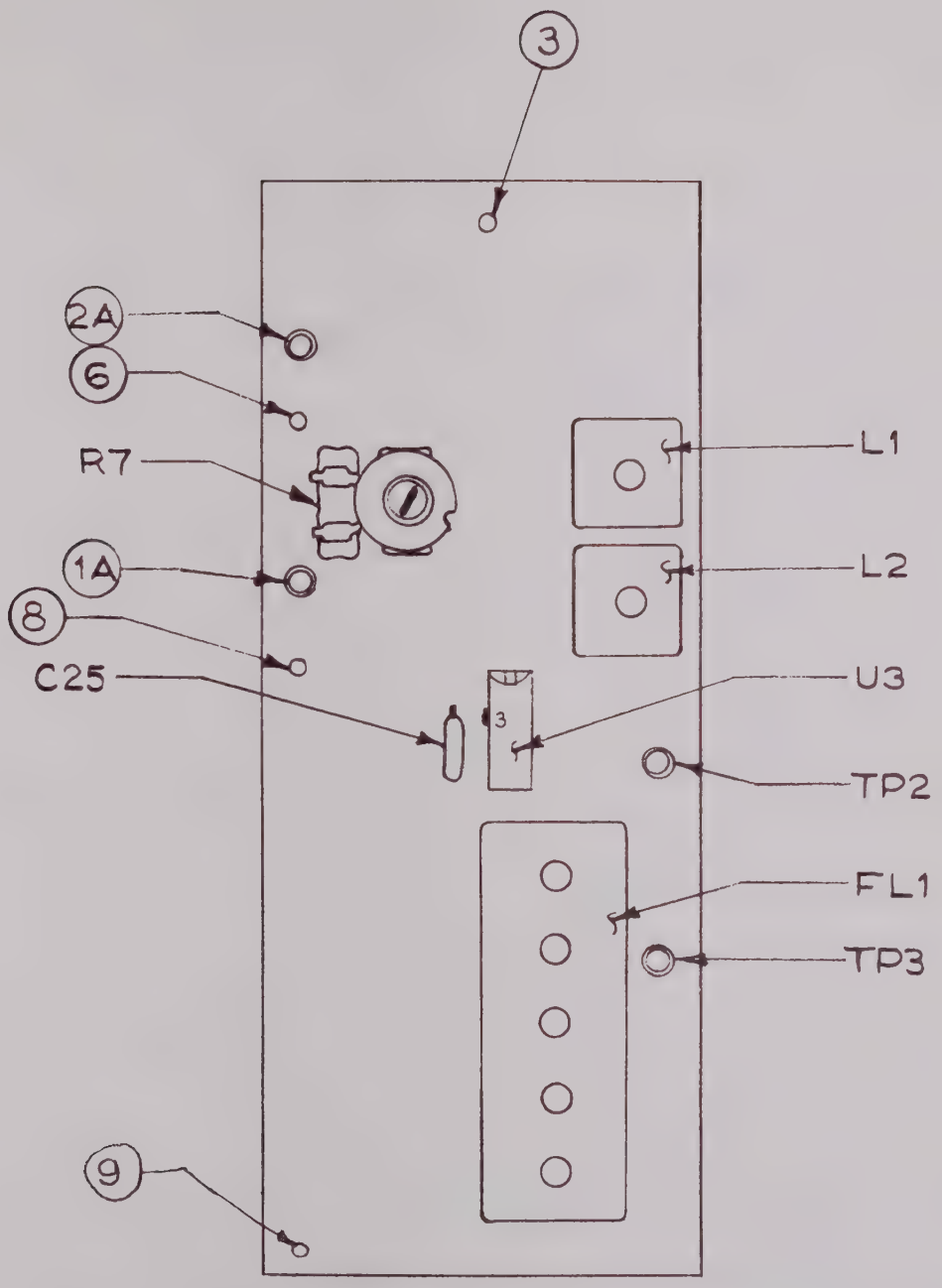


Figure 4-6. A3, A4, and A5 Board, Location Diagram

j. Adjust R7 for 3 V p-p (5.55 MHz) at TP-3.

k. Rotate 1 KHz frequency control between 0 and 9 and observe that level is 3 V p-p ±0.5 V in all positions. Return 1 KHz frequency control to 0.

4.5.6 BOARD A4 ADJUSTMENT (FIGURE 4-6).

a. Lift board A4 and connect Oscilloscope to pin 3 and ground. Voltage should be >2 V p-p at 5-6 MHz.

b. Connect Oscilloscope to TP-3 and set Mainframe 1 KHz and 10 KHz frequency controls at 4 and 0-1 KHz frequency control at 5.

c. Repeat steps 4.5.5b through g.

d. Adjust R7 for 3 V p-p frequency (5.55 MHz) at TP-3.

e. Rotate 10 KHz frequency control between 0 and 9 and observe that level is 3 V p-p ±0.5 V in all positions. Return 10 KHz frequency control to 0.

4.5.7 BOARD A5 ADJUSTMENT (FIGURE 4-6).

a. Lift board A5 and connect Oscilloscope to pin 3 and ground. Voltage should be >2V p-p at 5-6 MHz.

b. Connect Oscilloscope to TP-3 and set Mainframe 1 KHz, 10 KHz, and 100 KHz frequency controls at 4 and 0-1 KHz frequency control at 5.

c. Repeat steps 4.5.5.b through g.

d. Adjust R7 for 2.2 V p-p (5.55 MHz) at TP-3.

e. Rotate 100 KHz frequency control between 0 and 9 and observe that level is 2.2 V p-p ±10% in all positions. Return 100 KHz frequency control to 0.

4.5.8 BOARD A6 ADJUSTMENT (FIGURE 4-7).

a. Lift board A6 and connect Oscilloscope to pin 6 (5 to 6 MHz input) and ground. Voltage should be approximately 3.0 V p-p.

b. Measure voltage across pin 15 (36 to 45 MHz input) and ground. Voltage should be approximately 60 mV p-p.

c. Measure input voltage at pin 4. Voltage should be approximately 600 mV p-p at 90 MHz.

d. Set Mainframe 100 KHz frequency control at 5. Connect oscilloscope to TP-1. Voltage should be approximately 130 mV p-p (95.5 MHz).

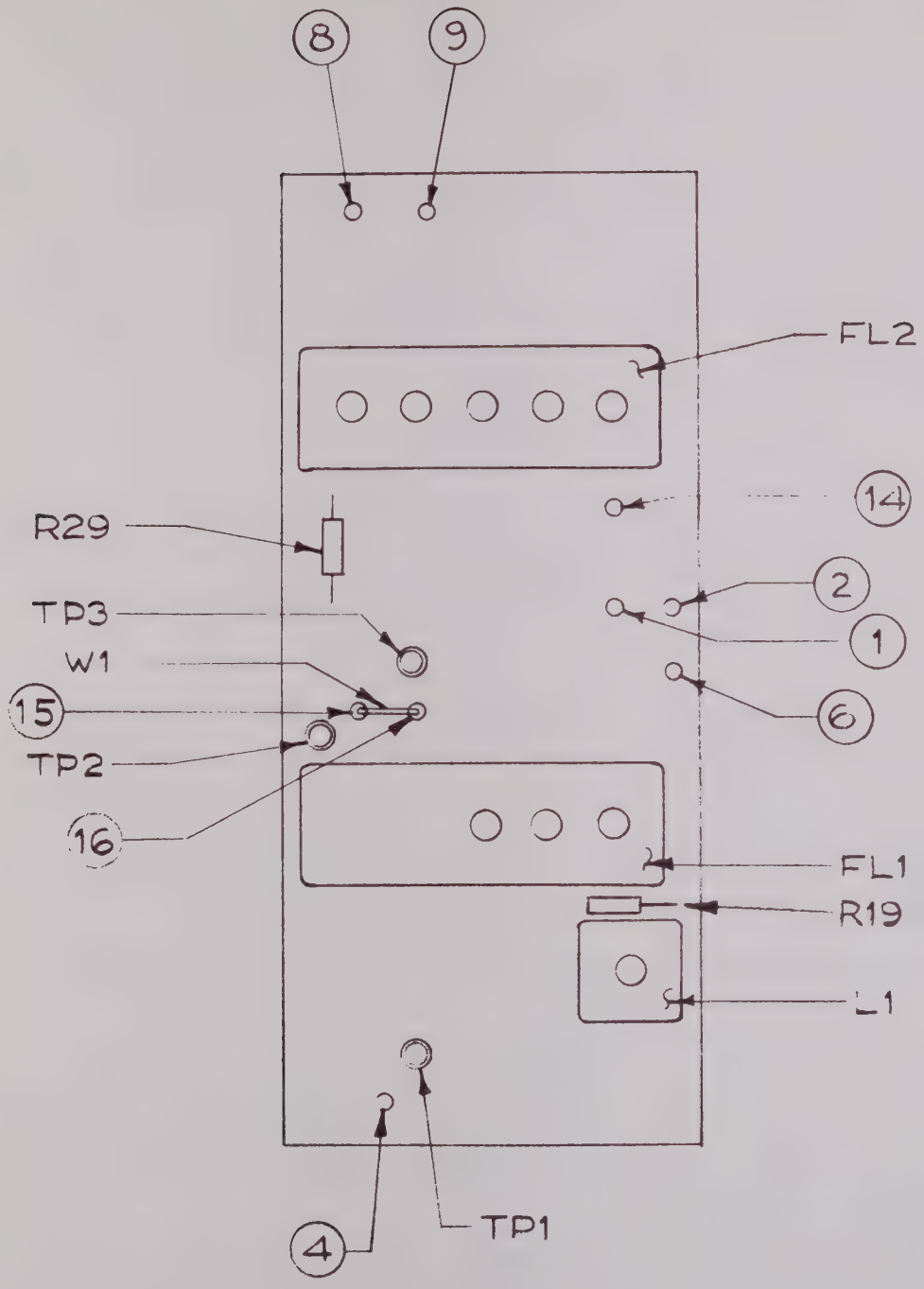


Figure 4-7. A6 Board, Location Diagram

e. Connect oscilloscope to TP-2. Adjust L1 for maximum output at 95.5 MHz. Voltage should be approximately 170 mV p-p.

f. Set Mainframe 10 MHz frequency control at 4. Connect Oscilloscope to TP-3. Voltage should be approximately 40 mV p-p (55.5 MHz).

g. Unsolder wire on pin 8. Connect center conductor of a 50-ohm coaxial test cable to pin 8 and connect outer conductor to pin 9.

h. Connect other end of test cable to RF Voltmeter and measure voltage level. Level should be -1 dbm ±2 db (use 50-ohm termination on RF Voltmeter). If level is not correct, select R29 for a -1 dbm ±2 db output level.

j. Disconnect test cable from RF Voltmeter.

4.5.9 BOARD A21 LOW FREQUENCY ADJUSTMENT (FIGURE 4-8).

a. Connect test cable used in step 4.5.8.g to Spectrum Analyzer. Set dispersion for 100 kHz with 60 MHz center frequency. Set amplitude at log scale and adjust gain for a dynamic range of at least 40 db (60 db preferable).

b. With 100 KHz and 1 MHz frequency controls at 0, pull board A21 out.

c. Connect Oscilloscope to pin 6. Observe that a 100 kHz spike of approximately 1.5 V p-p is present. Connect Oscilloscope to junction of Y2 and C6. Tune L1 for maximum amplitude, approximately 100 mV p-p.

d. Verify that 60 MHz (fo) output is present on Spectrum Analyzer. Tune C5 for minimum 100 kHz sidebands, 40 db down or greater. (See Fig. 5-10)

e. Connect RF Voltmeter to pin 20 and tune L3, L4, and L5 for maximum output.

f. If output level is other than -20 dbm ±1 db, select R28.

g. Dress all wires above center of board toward top of chassis and all wires below center of board toward bottom of chassis. Reinstall board A21.

4.5.10 BOARD A20 LOW FREQUENCY ADJUSTMENT (FIGURE 4-9).

a. Rotate 100 KHz and 1 MHz frequency controls to 1. Pull out board A20, re-center trace (fo = 58.9 MHz) on Spectrum Analyzer, and repeat steps c through g of paragraph 4.5.9.

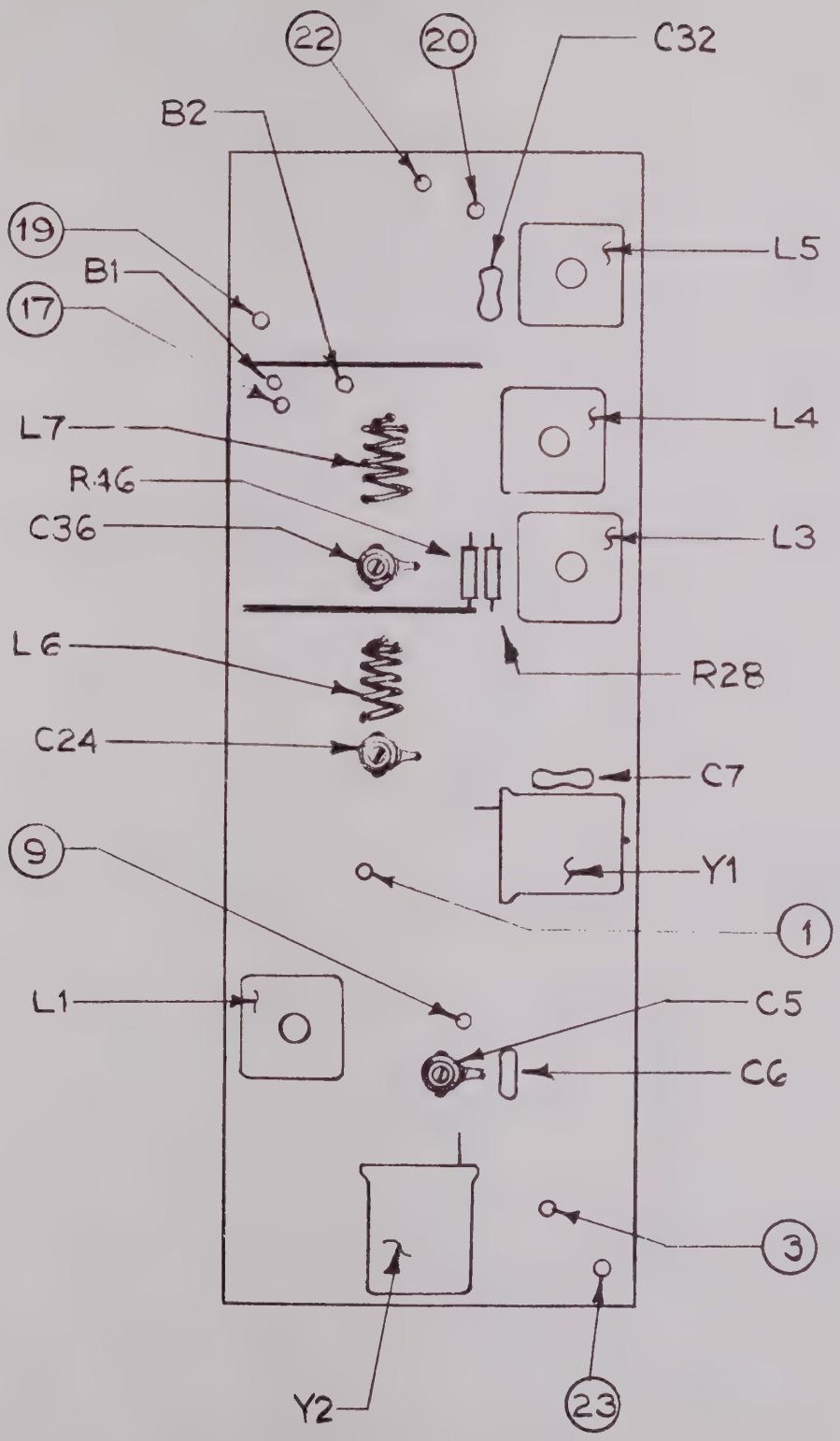


Figure 4-8. A21 Board, Location Diagram

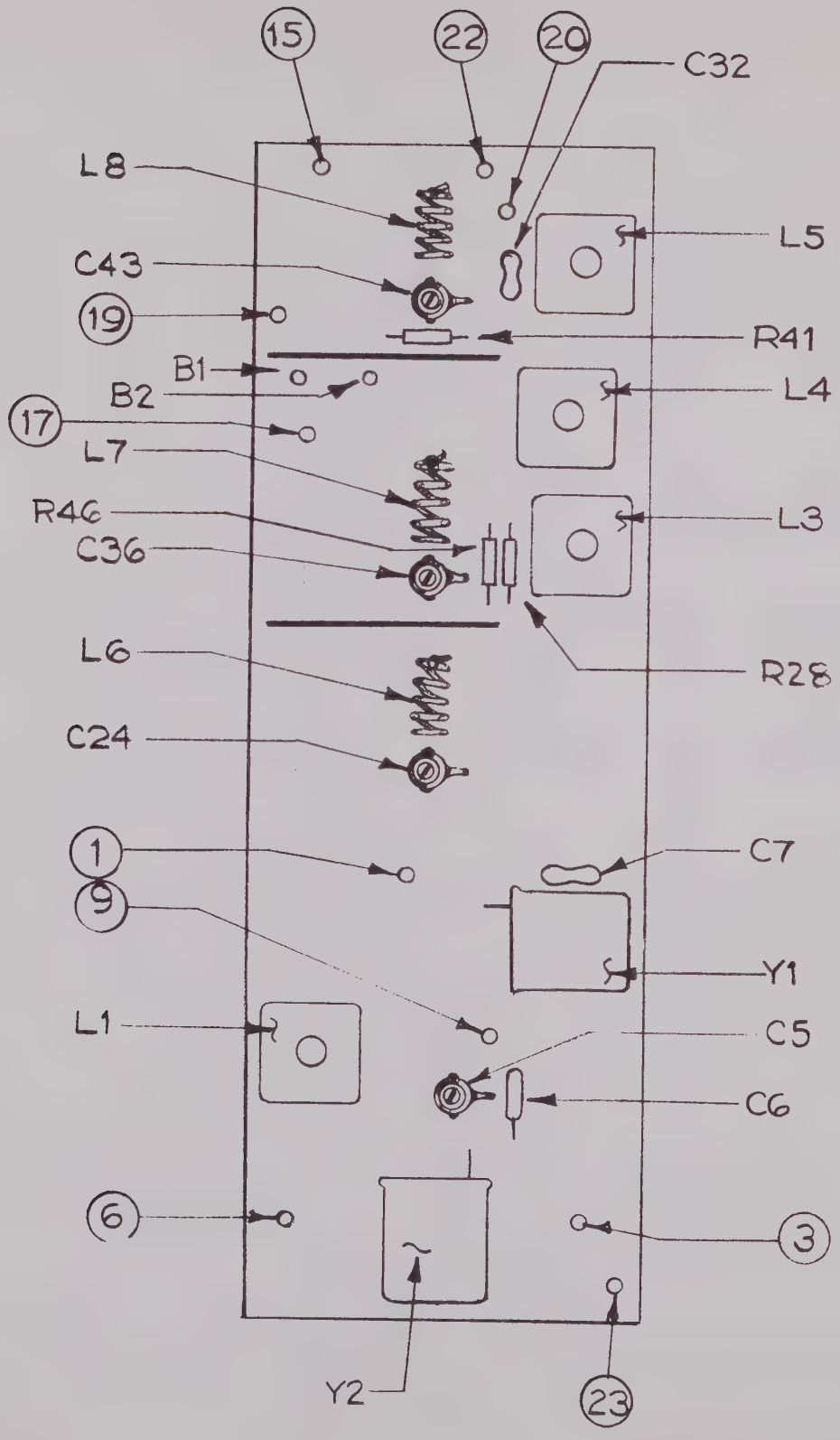


Figure 4-9. A16 - A20 Boards, Location Diagram

4.5.11 BOARD A19 LOW FREQUENCY ADJUSTMENT (FIGURE 4-9).

Rotate 100 KHz and 1 MHz frequency controls to 2. Pull out board A19, re-center trace (fo = 57.8 MHz) on Spectrum Analyzer, and repeat steps c through g of paragraph 4.5.9.

4.5.12 BOARD A18 LOW FREQUENCY ADJUSTMENT (FIGURE 4-9).

Rotate 100 KHz and 1 MHz frequency controls to 3. Pull out board A18, re-center trace (fo = 56.7 MHz) on Spectrum Analyzer, and repeat steps c through g of paragraph 4.5.9.

4.5.13 BOARD A17 LOW FREQUENCY ADJUSTMENT (FIGURE 4-9).

Rotate 100 KHz and 1 MHz frequency controls to 4. Pull out board A17, re-center trace (fo = 55.6 MHz) on Spectrum Analyzer, and repeat steps c through g of paragraph 4.5.9.

4.5.14 BOARD A16 LOW FREQUENCY ADJUSTMENT (FIGURE 4-9).

Rotate 100 KHz and 1 MHz frequency controls to 5. Pull out board A16, re-center trace (fo = 54.5 MHz) on Spectrum Analyzer, and repeat steps c through g of paragraph 4.5.9.

4.5.15 BOARD A15 LOW FREQUENCY ADJUSTMENT (FIGURE 4-10).

Rotate 100 KHz and 1 MHz frequency controls to 6. Pull out board A15, re-center trace (fo = 53.4 MHz) on Spectrum Analyzer, and repeat steps c through g of paragraph 4.5.9.

4.5.16 BOARD A14 LOW FREQUENCY ADJUSTMENT (FIGURE 4-10).

Rotate 100 KHz and 1 MHz controls to 7. Pull out board A14, re-center trace (fo = 52.3 MHz) on Spectrum Analyzer, and repeat steps c through g of paragraph 4.5.9.

4.5.17 BOARD A13 LOW FREQUENCY ADJUSTMENT (FIGURE 4-10).

Rotate 100 KHz and 1 MHz frequency controls to 8. Pull out board A13, re-center trace (fo = 51.2 MHz) on Spectrum Analyzer, and repeat steps c through g of paragraph 4.5.9.

4.5.18 BROAD A12 LOW FREQUENCY ADJUSTMENT (FIGURE 4-10).

a. Rotate 100 KHz and 1 MHz frequency controls to 9. Pull out board A12, re-center trace (fo = 50.1 MHz) on Spectrum Analyzer, and repeat steps c through g of paragraph 4.5.9.

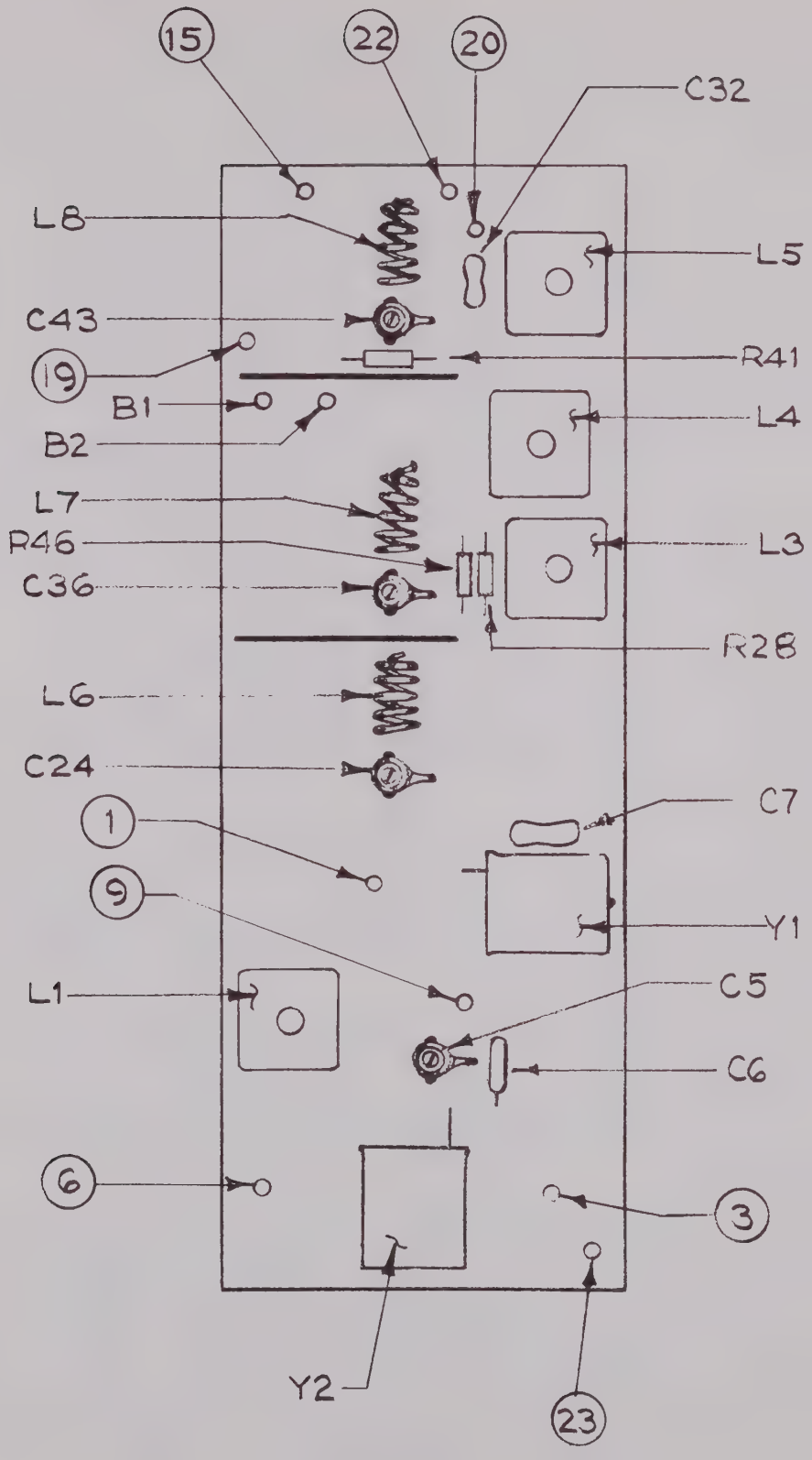


Figure 4-10. A12 - A15 Boards, Location Diagram

b. Set Spectrum Analyzer frequency dispersion at 1 MHz. Rotate 1 MHz frequency control from 9 to 0 and note that frequency change on Spectrum Analyzer is linear, 1 division per step.

c. Disconnect coaxial test cable on board A6 and reinstall original wires. Push board A6 down into compartment.

4.5.19 BOARD A21 HIGH FREQUENCY ADJUSTMENT (FIGURE 4-8).

a. Set 100 MHz and 10 MHz frequency controls at 0. Pull board A21 half way out.

b. Disconnect BNC connector on A8Z2I port (center connector) and connect BNC connector to RF Voltmeter (with 50Ω termination). See Figure 4-11.

c. Adjust C24 and C36 for 0 dbm ±2 db on RF Voltmeter.

d. If output is too high or low, remove cover and repeak C24 and C36.

e. If output is still too high, decrease value of C47 until output is 0 dbm ±2 db. Repeat C36 after changing C47.

f. If output is too low, increase value of C47 until output is 0 dbm ±2 db. Repeat C36 after changing C47.

g. Reinstall cover and repeak C24 and C36. Push board back into compartment. Disconnect RF Voltmeter and reconnect BNC cable to A8Z2I port.

4.5.20 BOARD A20 HIGH FREQUENCY ADJUSTMENT (FIGURE 4-9).

a. Set 10 MHz frequency control at 1. Pull board A20 half way out.

b. Unsolder coaxial cable center conductor from pin 17. Connect BNC test cable center conductor to pin 17 and shield to ground. Connect RF Voltmeter (with 50Ω termination) to test cable.

c. Adjust C24 and C36 for 0 dbm ±1 db on RF Voltmeter.

d. If output is too high or low, remove cover and repeak C24 and C36.

e. If output is too high, decrease value of C47 until output is 0 dbm ±1 db. Repeak C36 after changing C47.

f. If output is too low, increase value of C47 until output is 0 dbm ±1 db. Peak C36 after changing C47.

g. Disconnect RF Voltmeter from BNC test cable and unsolder test cable from pin 17. Resolder normal cable to pin 17.

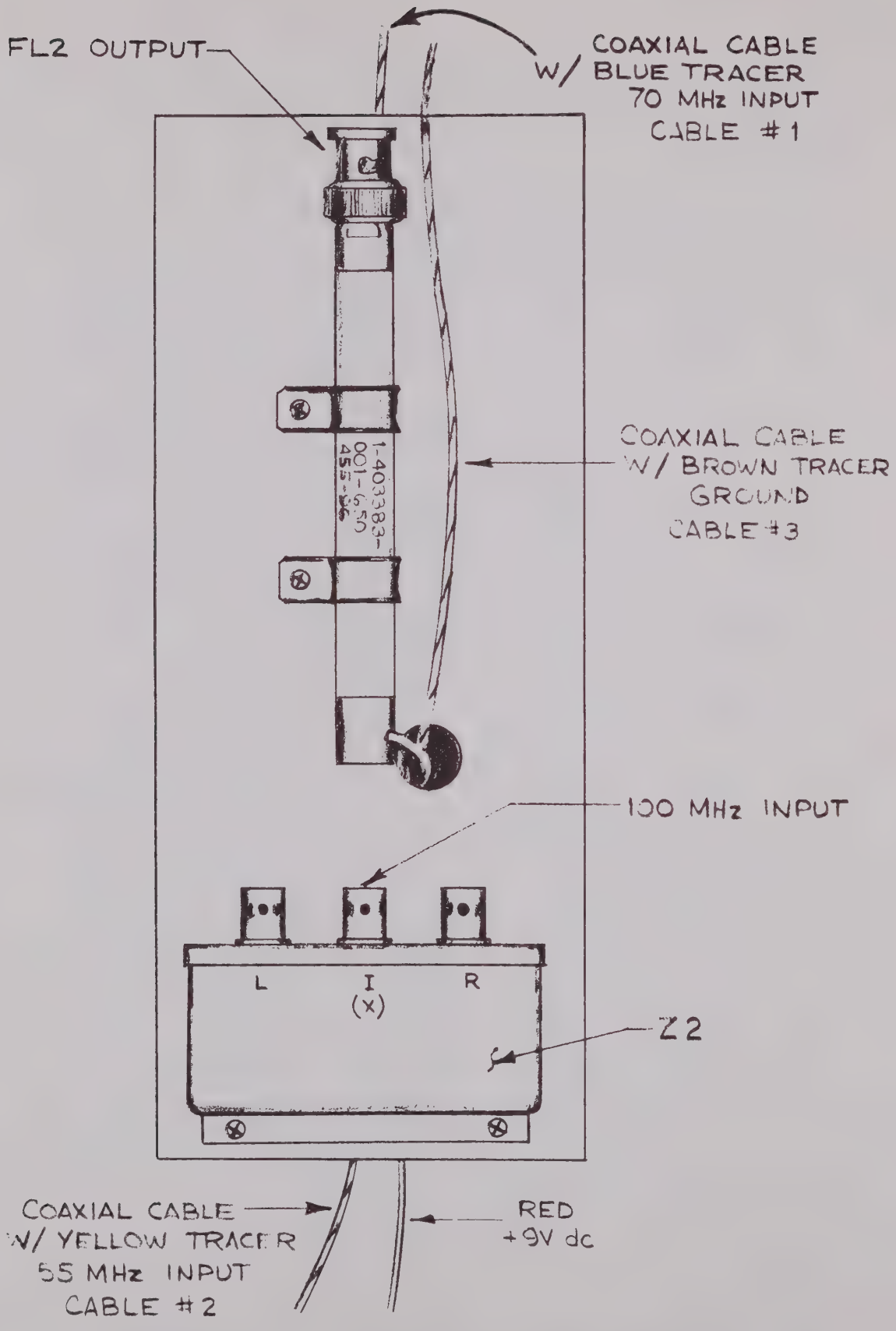


Figure 4-11. A7/A8 Assembly, Location Diagram

h. Disconnect the BNC connector from A8Z2 I port (center connector) and connect to RF Voltmeter (with 50Ω termination). Peak C43. Output should be 0 dbm ±2 db.

j. If output is too high, increase value of R41 until output is 0 dbm ±2 db. Repeak C43 after changing R41.

k. If output is too low, decrease value of R41 until output is 0 dbm ±2 db. Repeak C43 after changing R41.

l. Reinstall cover and repeak C24, C36, and C43.

m. Disconnect RF Voltmeter and reconnect BNC cable to A8Z2 I port. Push board back into compartment.

4.5.21 BOARD A19 HIGH FREQUENCY ADJUSTMENT (FIGURE 4-9).

a. Set 10 MHz frequency control at 2. Pull board A19 half way out.

b. Repeat steps 4.5.20.b through m.

4.5.22 BOARD A18 HIGH FREQUENCY ADJUSTMENT (FIGURE 4-9).

a. Set 10 MHz frequency control at 3. Pull board A18 half way out.

b. Repeat steps 4.5.20b through m.

4.5.23 BOARD A17 HIGH FREQUENCY ADJUSTMENT (FIGURE 4-9).

a. Set 10 MHz frequency control at 4. Pull board A17 half way out.

b. Repeat steps 4.5.20b through m.

4.5.24 BOARD A16 HIGH FREQUENCY ADJUSTMENT (FIGURE 4-9).

a. Set 10 MHz frequency control at 5. Pull board A16 half way out.

b. Repeat steps 4.5.20b through m.

4.5.25 BOARD A15 HIGH FREQUENCY ADJUSTMENT (FIGURE 4-10).

a. Set 10 MHz frequency control at 6. Pull board A15 half way out.

b. Disconnect BNC connector on A8Z2 I port (center connector) and connect BNC connector to RF Voltmeter (with 50Ω termination).

c. Adjust C24, C36, and C43 for 0 dbm ±2 db on RF Voltmeter.

d. If output is too high or low, remove cover and repeak C24, C36, and C43.

e. If output is still too high, decrease value of C47 or increase value of R41 until output is 0 dbm ±2 db. Repeat C24, C36, and C43 after changing C47 or R41.

f. If output is too low, increase value of C47 or increase value of R41 until output is 0 dbm ±2 db. Repeat C24, C36, and C43 after changing C47 or R41.

g. Reinstall cover and repeak C24, C36, and C43. Push board A15 back into compartment. Disconnect RF Voltmeter and reconnect BNC cable to A8Z2 I port.

4.5.26 BOARD A14 HIGH FREQUENCY ADJUSTMENT (FIGURE 4-10).

a. Set 10 MHz frequency control at 7. Pull board A14 half way out.

b. Repeat steps 4.5.25b through g.

4.5.27 BOARD A13 HIGH FREQUENCY ADJUSTMENT (FIGURE 4-10).

a. Set 10 MHz frequency control at 8. Pull board A13 half way out.

b. Repeat steps 4.5.25b through g.

4.5.28 BOARD A12 HIGH FREQUENCY ADJUSTMENT (FIGURE 4-10).

a. Set 10 MHz frequency control at 9. Pull board A12 half way out.

b. Repeat steps 4.5.25b through g.

4.5.29 BOARD A8 ADJUSTMENT (FIGURE 4-12).

a. Remove mounting screws and lift assembly A7/A8. With Oscilloscope, observe 70 MHz at pin 5. Peak C13 on board A11. Voltage should be approximately 2 V p-p. Connect Oscilloscope probe to pin 1 and peak C28 and C30 for maximum output.

b. Peak C3, C6, C9, and C12 on A8 for maximum output on RF Voltmeter connected in place of L on A9Z1. Verify that RF Voltmeter reads -24 dbm. Reconnect A9Z1.

c. Rotate 100 MHz and 1 MHz frequency controls to 4. Disconnect BNC connector from A8Z2 R port and connect RF Voltmeter. Peak C21, C18, and select C33 and C35 for +5 dbm on RF Voltmeter.

d. Rotate 100 KHz and 1 MHz frequency controls from 0 to 9. Output should be +5 dbm ±2 db.

e. Disconnect RF Voltmeter and reconnect BNC cable to R port of A8Z2.

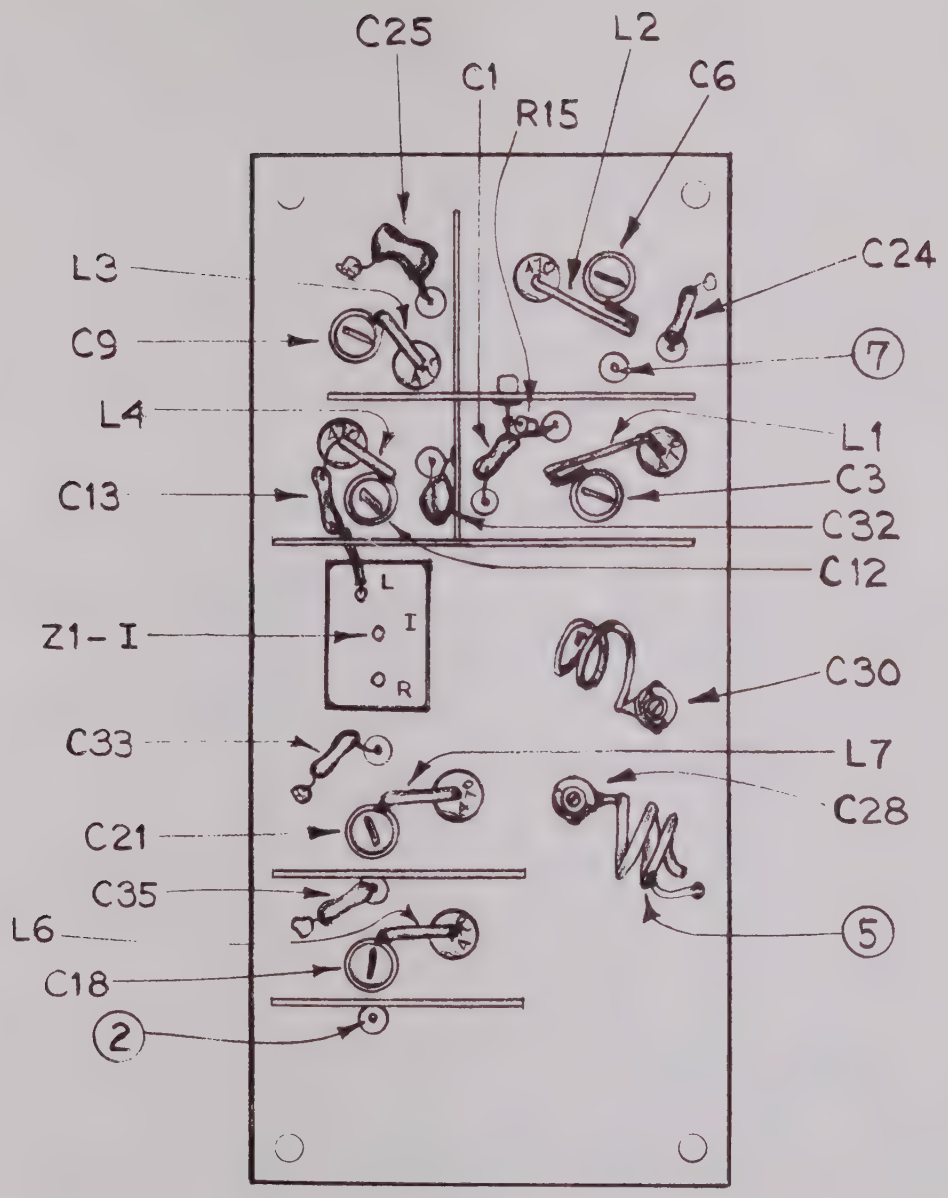


Figure 4-12. A8 Board, Location Diagram

4.5.30 BOARDS A10 AND A11 ADJUSTMENTS (FIGURES 4-13, 4-14, AND 4-15).

NOTE: Boards A10 and A11 must be aligned together. Adjustment of A11C13 is performed during board A8 adjustment, paragraph 4.5.29.

a. Set 100 MHz and 10 MHz frequency controls at 0. Pull board A11 half way out.

b. Disconnect BNC connector from A9Z1 R port and connect Spectrum Analyzer input to BNC cable (see Figure 6-1).

c. Set Spectrum Analyzer dispersion to 10 MHz/division with 700 MHz center frequency.

d. Remove cover from A10. Connect Oscilloscope probe to A10 pin 1. Tune A11C5 for maximum output on Oscilloscope. Remove Oscilloscope probe.

e. Tune A10C2, C5, C8, and C11 for maximum output with minimum sidebands, 30 db down or greater, on Spectrum Analyzer. (See Fig. 5-10)

f. Disconnect Spectrum Analyzer and connect RF Voltmeter (with 50Ω termination). Output should be +5 dbm -2 + 4 db.

g. If output is too high or low, change value of C71, C70, or C76 until output is +5 -2 + 4 db. Disconnect RF Voltmeter and reconnect Spectrum Analyzer.

h. Set 100 MHz frequency control at 1 and 10 MHz frequency control at 1. Set Spectrum Analyzer center frequency at 800 MHz.

j. Connect Oscilloscope probe to A10 pin 5. Tune A11C21 for maximum output on Oscilloscope. Remove Oscilloscope probe.

k. Tune A10 C15, C18, C22, and C25 for maximum output with minimum sidebands, 30 db down or greater, on Spectrum Analyzer. (See Fig. 5-10)

l. Repeat step f.

m. If output is too high or low, change value of C72, C21, or C77 until output is +5 dbm -2 +4 db. Disconnect RF Voltmeter and reconnect Spectrum Analyzer.

n. Set 100 MHz frequency control at 2 and 10 MHz frequency control at 2. Set Spectrum Analyzer center frequency at 900 MHz.

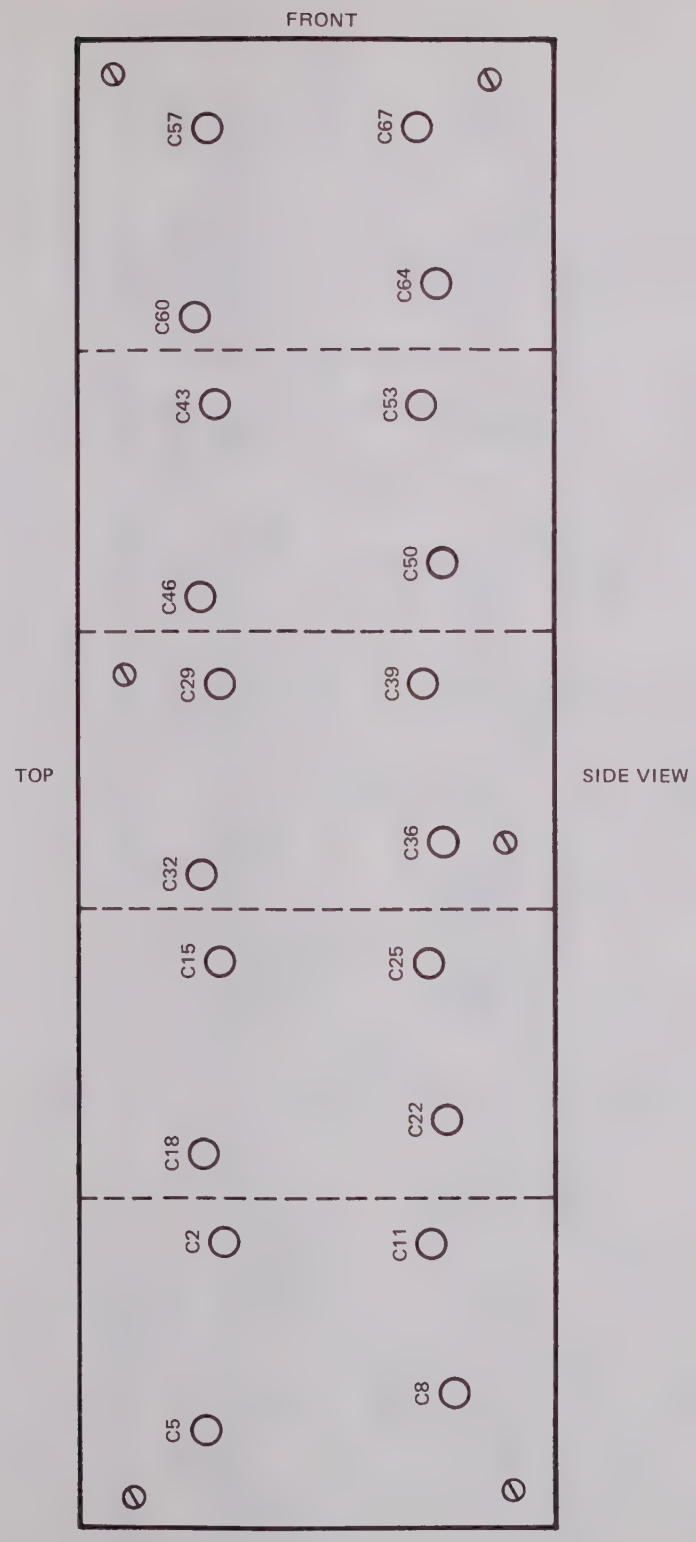


Figure 4-13. A10 Assembly, Access Hole Identification

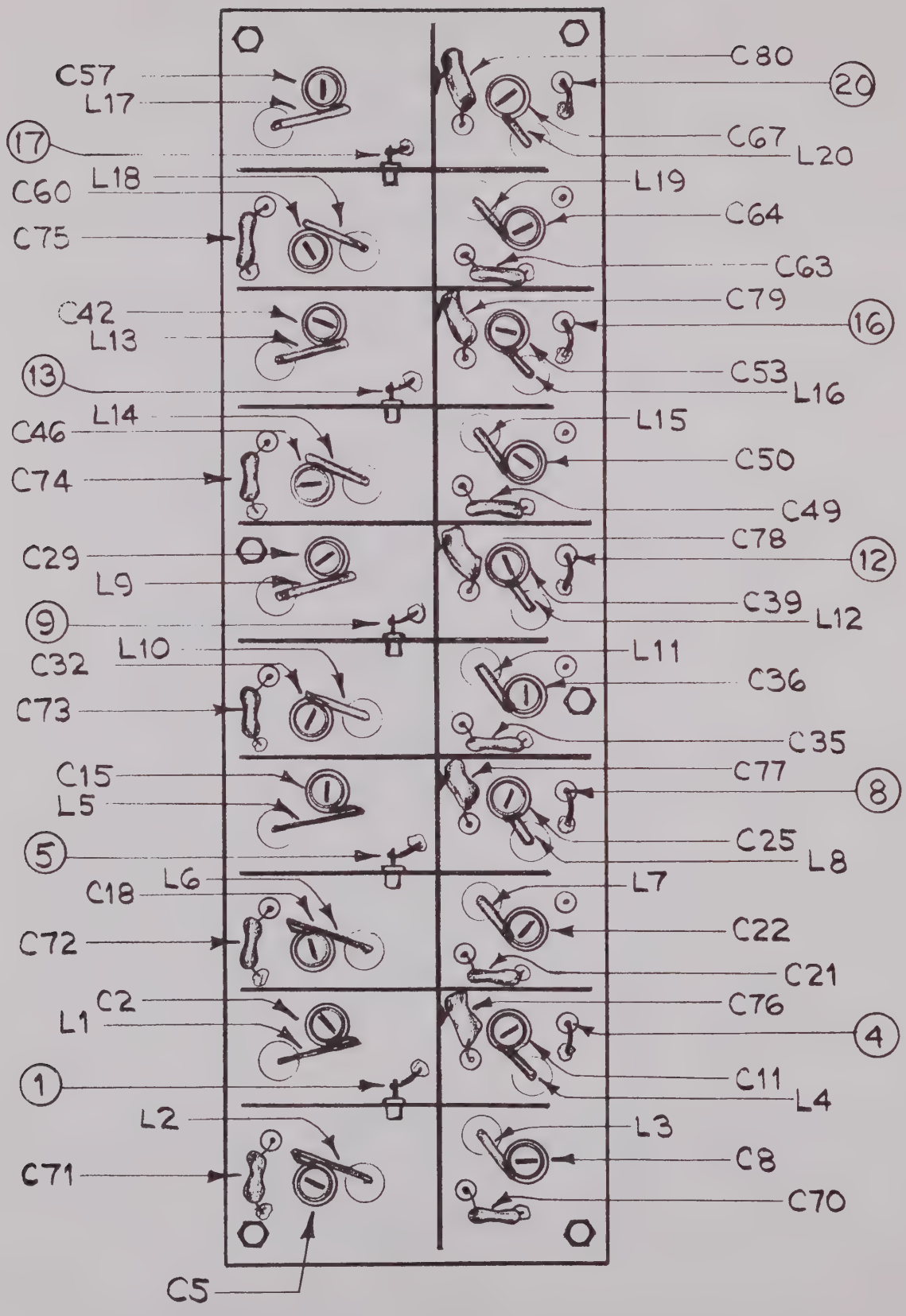


Figure 4-14. A10 Assembly, Location Diagram

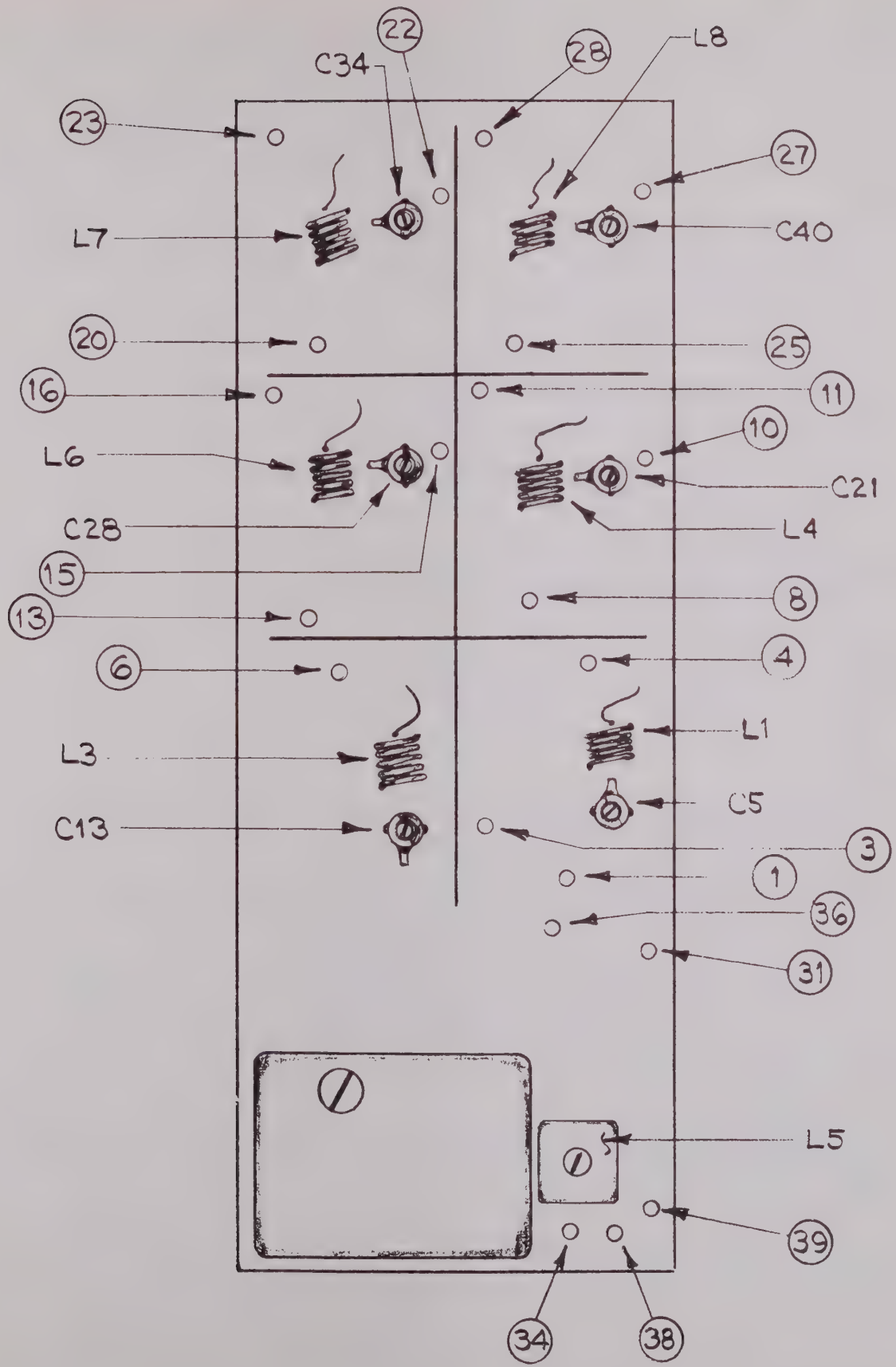


Figure 4-15. All Board, Location Diagram

p. Connect Oscilloscope probe to A10 pin 9. Tune A11 C28 for maximum output on Oscilloscope. Remove Oscilloscope probe.

q. Tune A10 C29, C32, C36, and C39 for maximum output with minimum sidebands, 30 db down or greater, on Spectrum Analyzer. (See Fig. 5-10)

r. Repeat step f.

s. If output is too high or low, change value of C73, C35, or C78 until output is +5 dbm -2 +4 db. Disconnect RF Voltmeter and reconnect Spectrum Analyzer.

t. Set 100 MHz frequency control at 3 and 10 MHz frequency control at 3. Set Spectrum Analyzer center frequency at 1 GHz.

u. Connect Oscilloscope probe to A10 pin 13. Tune A11C34 for maximum output on Oscilloscope. Remove Oscilloscope probe.

v. Tune A10C43, C46, C50, and C53 for maximum output with minimum sidebands, 30 db down or greater, on Spectrum Analyzer. (See Fig. 5-10)

w. Repeat step f.

x. If output is too high or low, change value of C74, C49, or C79 until output is +5 dbm -2 +4 db. Disconnect RF Voltmeter and reconnect Spectrum Analyzer.

y. Set 100 MHz frequency control at 4 and 10 MHz frequency control at 4. Set Spectrum Analyzer center frequency at 1.1 GHz.

z. Connect Oscilloscope probe to A10 pin 17. Tune A11C40 for maximum output on Oscilloscope. Remove Oscilloscope probe.

aa. Tune A10C57, C60, C64, and C67 for maximum output with minimum sidebands, 30 db down or greater, on Spectrum Analyzer. (See Fig. 5-10)

ab. Repeat step f.

ac. If output is too high or low, change value of C75, C63, or C80 until output is +5 dbm -2 +4 db. Disconnect RF Voltmeter and reconnect Spectrum Analyzer.

ad. Reinstall cover on A10 and set 100 MHz and 10 MHz frequency controls at 0. Push board A11 back into compartment.

ae. Repeat steps c, e, and f.

af. Disconnect RF Voltmeter and reconnect Spectrum Analyzer.

ag. Repeat steps h and k.

ah. Disconnect RF Voltmeter and reconnect Spectrum Analyzer.

aj. Repeat steps n and q.

ak. Repeat steps 4.5.30t and v.

al. Repeat steps 4.5.30y and aa.

am. Disconnect Spectrum Analyzer from BNC cable and reconnect BNC cable to A9Z1 R port.

4.5.31 BOARD A7 ADJUSTMENT (FIGURE 4-16).

a. Disconnect BNC connector from A8Z2 L port and connect to RF output jack on Sweep Generator.

b. Disconnect center conductor of coaxial cable at pin 6 and connect center conductor of a 50Ω coaxial cable (BNC connector on other end) to pin 6, and shield to ground. Connect BNC connector on this cable to RF input on RF Detector. Connect dc output of RF Detector to Sweep Generator DEMOD IN jack.

c. Set Sweep Generator output at -8 dbm (Δf).

d. Connect Oscilloscope vertical input jack and external horizontal input jack to Sweep Generator vertical and horizontal output jacks, respectively.

e. Adjust Sweep Generator SWEEP WIDTH and CENTER FREQ controls so that 600 and 700 MHz markers are displayed on Oscilloscope.

f. Disconnect ALC lead at pin 1 and connect 0-5 V dc power supply (+) lead, connect (-) lead to ground. Set output voltage at 0 V.

g. Adjust C25, C26, C28, and C31 for maximum output and flattest response between 600 and 700 MHz.

h. Disconnect BNC connector at RF Detector RF input and connect to RF Voltmeter (with 50Ω termination). Set Sweep Generator MODE switch at CW.

j. Verify that level at pin 4 is -8 dbm. Vary Sweep Generator CENTER FREQ control from 600 MHz to 700 MHz. Output level should not change more than ±2 dbm from -12 dbm.

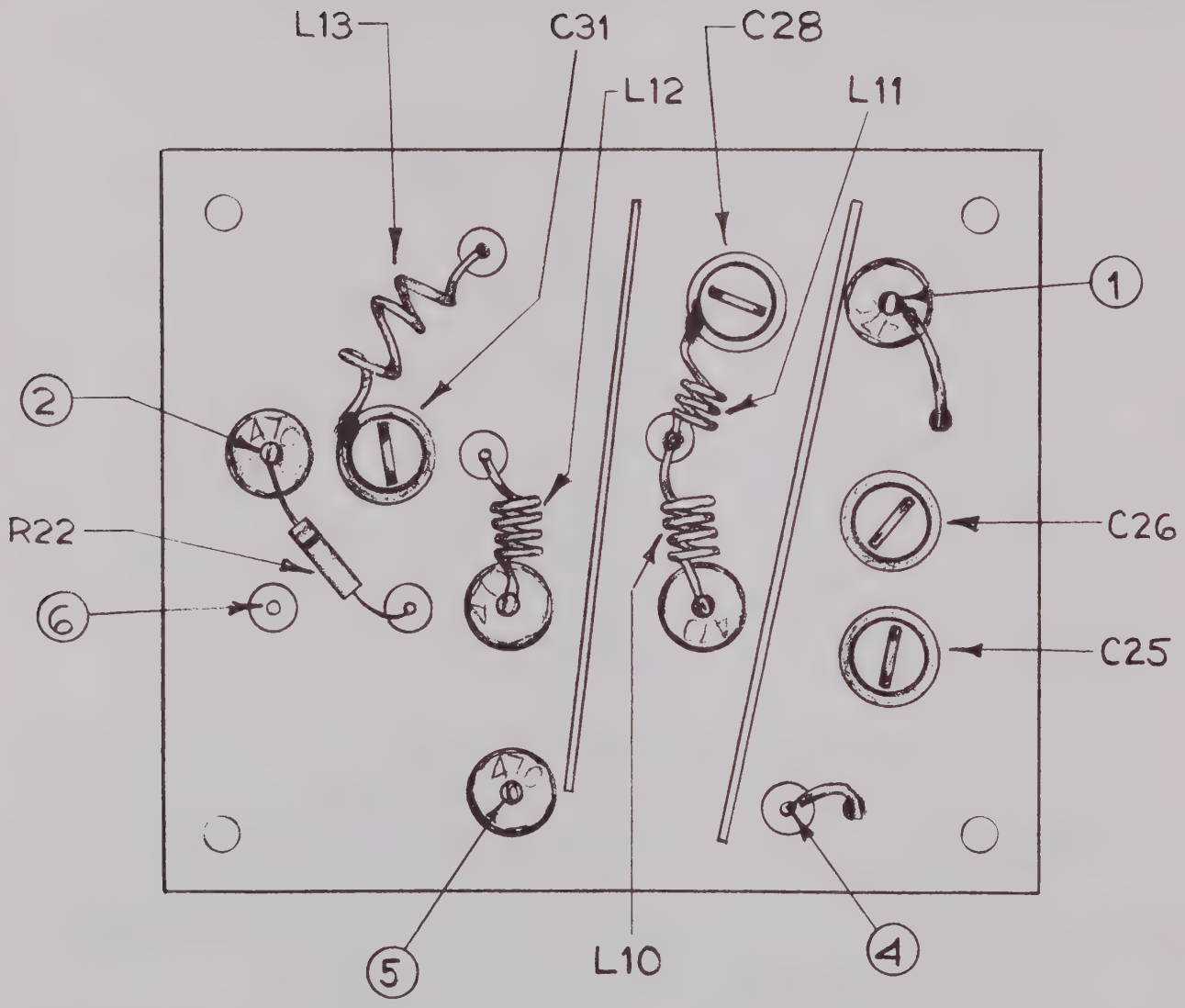


Figure 4-16. A7 Board, Location Diagram

k. Increase 0 to 5 V dc power supply at pin 1 to +5 V dc. Output level should drop a minimum of 28 db from level measured in step j.

l. Disconnect test equipment from board and reconnect cables and wire to their proper locations.

m. Disconnect BNC cable from A9FL-3 at A9Z1 X port. Connect a 50Ω termination to Oscilloscope vertical input jack. Connect a 50Ω BNC to BNC coaxial cable between 50Ω termination and A9Z1 X port.

n. Install AFM-2 or OAM-1 in Mainframe right-hand compartment. If AFM-2 is used, connect Audio Oscillator to AM MOD jack and Oscilloscope external horizontal input jack. If OAM-1 is used, rotate INT MOD/AUDIO OUT control CW to turn it on and set MOD MODE switch at EXT. Connect Audio Oscillator to OAM-1 EXT MOD/HORIZ IN jack and Oscilloscope external horizontal input jack.

p. Set Mainframe frequency controls at 2 MHz. Connect AC VTVM to pin 2.

q. Set Audio Oscillator frequency at 1 kHz and adjust its output level to obtain 75 mV rms at pin 2.

r. Adjust Oscilloscope controls to obtain a trapezoid pattern 5 divisions in width and 4 divisions high for E maximum E minimum should be between 2.3 and 2.0 divisions (27% to 33% modulation). If E minimum is not within 2.3 and 2.0 divisions, select R22 for approximately 2.15 divisions (30% modulation). Reconnect BNC cable to A9Z1 X port.

4.5.32 A1A2 ADJUSTMENT (FIGURE 4-3).

a. Turn Mainframe off and pull left-hand module half-way out. Install extender cable PC2652 and apply power.

b. Disconnect BNC on input to variable attenuator and connect RF Voltmeter to BNC mounted on chassis.

c. Set synthesizer frequency at 250 MHz and adjust R31 for an output of -23 dbm on RF Voltmeter.

d. Rotate 100 MHz, 10 MHz, and 1 MHz frequency controls through their ranges. Output should not vary more than ±1 db. Readjust R31 if necessary.

e. Disconnect RF Voltmeter and reconnect input to variable attenuator. Remove extender cable and reinstall left-hand module.

4.5.33 CALIBRATION OF TCXO (Figure 4-17).

4.5.33.1 With Outer Case Removed.

a. Connect RF OUTPUT jack to input of Broadband Amplifier. Connect Broadband Amplifier output to Frequency Counter.

b. Set frequency controls at 10.000 MHz.

c. Remove protective cap screw on TCXO. Apply power and adjust trimmer for Frequency Counter reading of 10 MHz plus or minus offset indicated on TCXO.

4.5.33.2 With Outer Case On. If the error displayed on the TCXO is known, it is not necessary to remove outer case. Unit must, however, be turned off and left for 4 hours at 25°C.

a. Rotate sliding cover away from access hole and remove cap screw (if accidentally missing, do not mistake trimmer for cap screw).

b. Apply power and within 60 seconds adjust trimmer so that Frequency Counter registers 10 MHz plus or minus offset indicated on TCXO.

4.6 FAULT ISOLATION PROCEDURES

Fault isolation procedures are presented to provide a guide in servicing the FM-10. The procedures follow the sequence of the Minimum Performance Checkout Procedures, Section 4.4, with each subsection keyed to the paragraph in Section 4.4 that first indicates a fault. When a fault is noted during FM-10 operation, proceed as follows:

a. Perform checkout procedures in Section 4.4.

b. Start fault isolation procedures at the point where minimum performance cannot be satisfied.

c. When the fault is isolated to a subassembly, such as gain control amplifier A7, refer to the alignment procedure for that subassembly in Section 4.5, and check alignment of subassembly before proceeding with fault isolation.

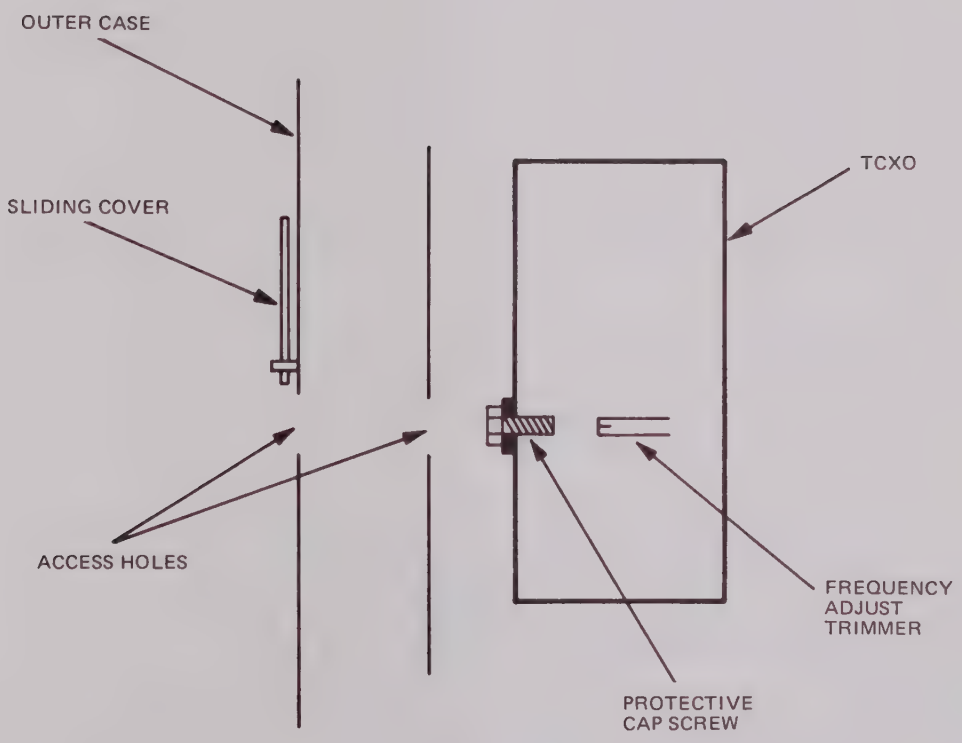


Figure 4-17. Access to TCXO

d. After a fault is repaired, complete the minimum performance checkout procedure to determine if further alignment is necessary.

> WARNING
>
> High voltages are present throughout the unit. Appropriate precautions should be taken while operating the instrument with the cover removed.

4.6.1 PWR INDICATOR FAILURE (4.4.1b). If PWR indicator fails to come on in step 4.4.1b, proceed as follows:

a. Refer to Figure 5-1 and check voltages and waveforms indicated in power supply section.

b. If voltages and waveforms are within tolerance, replace PWR indicator lamp DS1.

c. If fault still exists, check board assembly A1A3 voltages per Figure 5-2.

4.6.2 BEAT INDICATOR FAILURE (4.4.2b) AND 0-1 kHz TONE FAILURE (4.4.2c). These faults are interrelated.

a. If audio tone is present but BEAT indicator does not come on, check board assembly A1A2 and replace BEAT indicator lamp DS2. Check for +12 V at BEAT indicator lamp DS2. If not within tolerance, check +12 V power supply circuit on board assembly A1A3.

b. If audio tone is not present, connect Audio Oscillator 50 output to MEASURE INPUT connector. Push 10 MHz switch to OUT position, set Audio Oscillator at 1 kHz with a level of 2 V rms output. Verify that 1 kHz tone is heard in speaker.

c. If audio tone is still not present, check beat detector circuitry on board assembly A1A4, audio circuitry on board assembly A1A3, VOLUME control, and speaker.

4.6.3 AUDIO TONE FAILS TO INCREASE (4.4.2d). Check the 3.6 to 4.5 MHz output of appropriate PC board assembly A12 through A21 and S6 wiring.

4.6.4 NO OUTPUT FROM REMOTE SPEAKER/HEADSET (4.4.2e). Check AUDIO OUTPUT jack and associated wiring.

4.6.5 FREQUENCY NOT WITHIN TOLERANCE (4.4.3f-m).

a. Check accuracy of TCXO output and calibrate as directed in paragraph 4.5.33.

b. If all frequencies in decade (frequency control) are out of tolerance, consult Table 4-2 for source of trouble. If any digit in decade is out of tolerance, consult Table 4-3 for source of trouble.

TABLE 4-2. DECADE FAULT ISOLATION CHART

DECADE	ASSY NO.
100MHz	A9
10MHz	A8
1MHz	A6
100 KHz	A5
10 KHz	A4
1 KHz	A3
0-1 KHz	A2

TABLE 4-3. DIGIT FAULT ISOLATION CHART

DIGIT	FREQUENCY CONTROL			
	100 MHz	10 MHz	1 MHz	100 KHz, 10 KHz, 1 KHz
0	A9/A10 (700 MHz)	A21 (60 MHz)	A21 (36 MHz)	A21 (3.6 MHz)
1	A9/A10 (800 MHz)	A20 (70 MHz)	A20 (37 MHz)	A20 (3.7 MHz)
2	A9/A10 (900 MHz)	A19 (80 MHz)	A19 (38 MHz)	A19 (3.8 MHz)
3	A9/A10 (1000 MHz)	A18 (90 MHz)	A18 (39 MHz)	A18 (3.9 MHz)
4	A9/A10 (1100 MHz)	A17 (100 MHz)	A17 (40 MHz)	A17 (4.0 MHz)
5	--	A16 (110 MHz)	A16 (41 MHz)	A16 (4.1 MHz)
6	--	A15 (120 MHz)	A15 (42 MHz)	A15 (4.2 MHz)
7	--	A14 (130 MHz)	A14 (43 MHz)	A14 (4.3 MHz)
8	--	A13 (140 MHz)	A13 (44 MHz)	A13 (4.4 MHz)
9	--	A12 (150 MHz)	A12 (45 MHz)	A12 (4.5 MHz)

4.6.6 ALL OUTPUT LEVELS NOT WITHIN TOLERANCE (4.4.4d, e).

a. Verify that output of broadband amplifier A1A4-9 is -23 dbm ±1.5 db.

b. If output of broadband amplifier A1A4-9 is within tolerance, proceed as follows:

(1) Set RF OUTPUT attenuator at 500 V and set knob to agree with front panel 500 V line.

(2) Connect Broadband Amplifier (BBA-1) between RF Voltmeter and Mainframe RF OUTPUT jack.

(3) Note output level and decrease output 20 db by RF OUTPUT attenuator.

(4) Observe RF Voltmeter and verify that output decreases 20 db ±2 db.

(5) If voltmeter indication is not within tolerance, replace variable attenuator.

(6) If RF OUTPUT attenuator cannot be set at 500 V, check AT1 (10 db pad) before replacing variable attenuator.

c. If output of broadband amplifier A1A4-9 is not within tolerance, proceed as follows:

(1) Verify that input of Z1 mixer "R" port is +5 dbm ±2 db.

(2) If input of Z1 is within tolerance, short terminal A1A2-15 to ground and verify that output of FL3 is approximately -11 dbm.

(3) If output of FL3 is not within tolerance, check level detector (A1A4) for approximately -20 dbm ±1.5 db at output bandpass filter FL3.

(4) If output is within tolerance, replace broadband amplifier A1A4.

4.6.7 SOME OUTPUT LEVELS NOT WITHIN TOLERANCE (4.4.4d, e). If some test frequency levels are out of tolerance use Table 5-2 and 5-3 to isolate the trouble to the particular board assembly causing the trouble.

4.6.8 INSUFFICIENT CARRIER LEVEL CONTROL (4.4.5.1g). Check the level of the 2 MHz output at A1A3 terminal 7 for 2.5 mV ±10%. If not within tolerance, check board assembly A1A3. If within tolerance, refer to OAM-1 instruction manual to locate the fault.

4.6.9 INSUFFICIENT AM SENSITIVITY (4.4.5.2e). Check input level A7 terminal 2 for 75 mV ±10%. If within tolerance check board assembly A7. If not within tolerance use OAM-1 instruction manual to locate fault.

4.6.10 EXCESSIVE AM DISTORTION (4.4.5.3c). Check at A7 terminal 2 for 1% maximum distortion. If within tolerance check board assembly A7. If not within tolerance use OAM-1 instruction manual to locate fault.

4.6.11 INSUFFICIENT FM SENSITIVITY (4.4. 6h). Check at A2 terminal 6 for 500 mV ±10% (5 kHz deviation in narrowband position). If within tolerance, check board assembly A2. If not within tolerance use ODM-1 instruction manual to locate fault.

4.6.12 MEASURE INPUT SENSITIVITY NOT WITHIN TOLERANCE (4.4.7d). Check 2 MHz IF output for 2.5 mV ±10%. If not within tolerance, check A1A4. If within tolerance use ODM-1 instruction manual to locate fault.

4.6.13 OVERLOAD INDICATION NOT WITHIN TOLERANCE (4.4.7e). Check 2 MHz IF output for 25 mV ±10%. If not within tolerance, check A1A4. If within tolerance use ODM-1 instruction manual to locate fault.

SECTION V

FM-10 SCHEMATIC DIAGRAMS

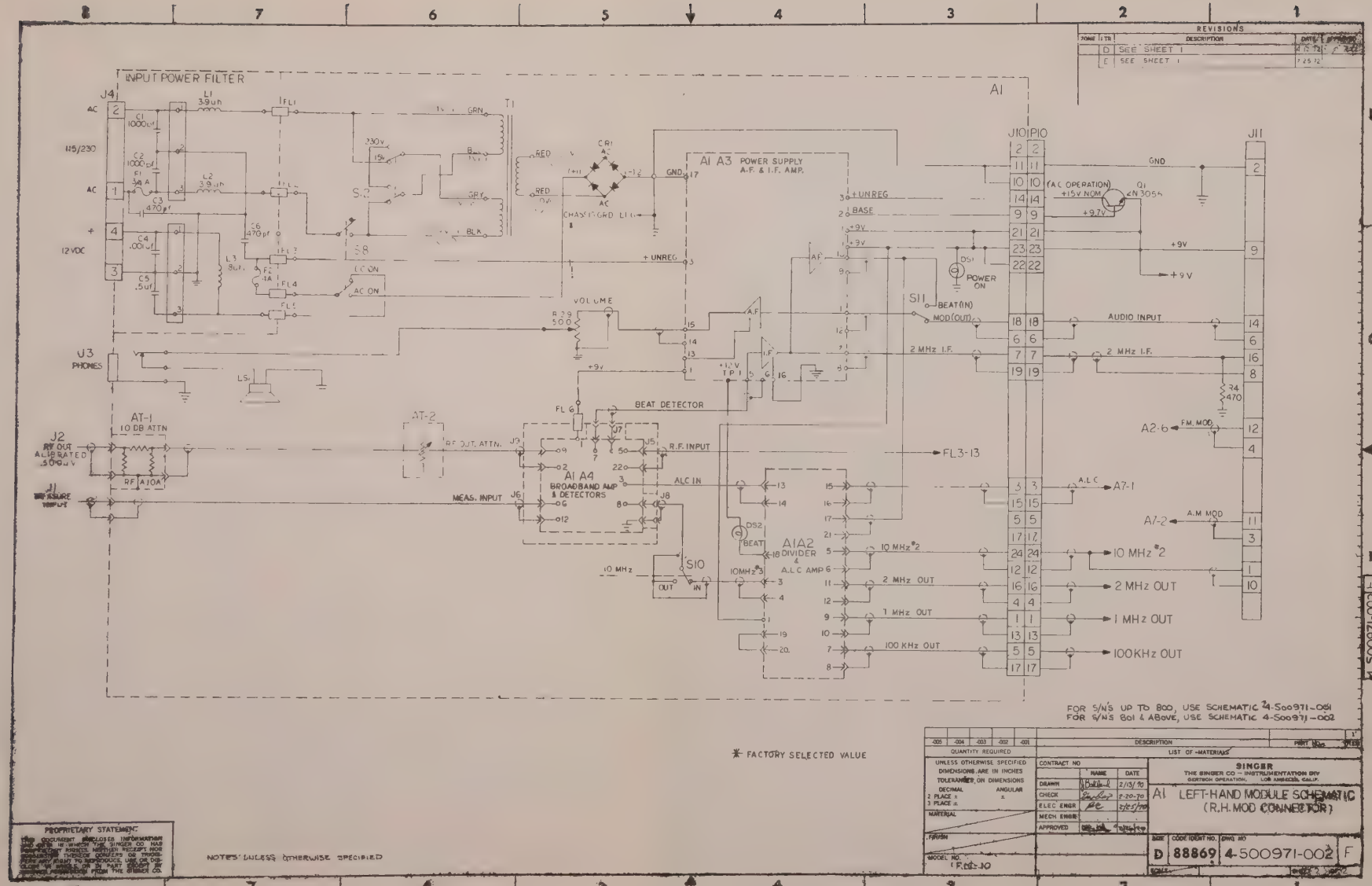
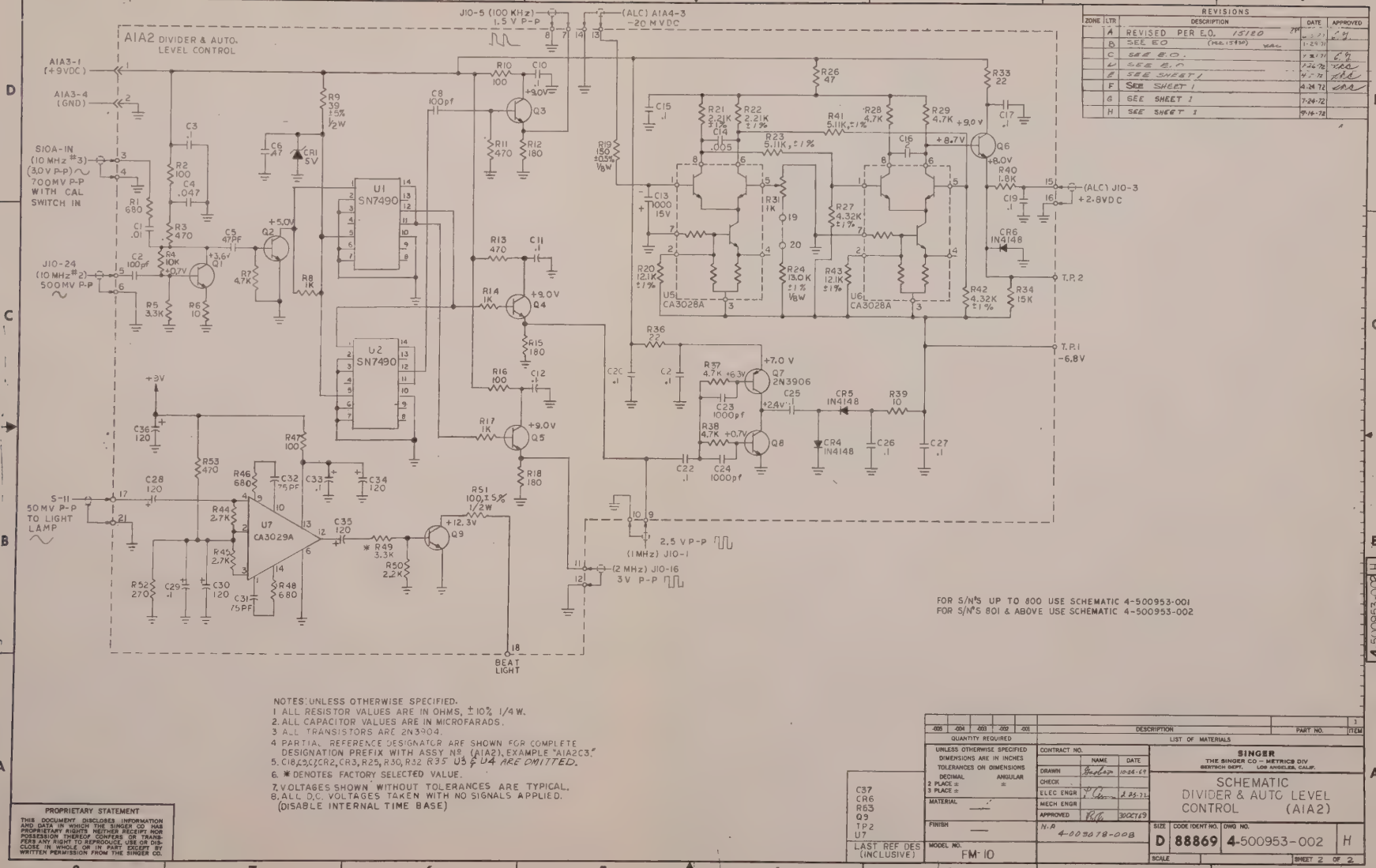


Figure 5-1. Left-Hand Module (A1), Schematic Diagram



REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	A	REVISED PER E.O. 15180		
	B	SEE EO (per 15430)	1-29-71	
	C	SEE E.O.	7-21-71	
	D	SEE E.O.	1-24-72	
	E	SEE SHEET 1	4-7-72	
	F	SEE SHEET 1	4-24-72	
	G	SEE SHEET 1	7-24-72	
	H	SEE SHEET 1	9-16-72	

FOR S/N'S UP TO 800 USE SCHEMATIC 4-500953-001
FOR S/N'S 801 & ABOVE USE SCHEMATIC 4-500953-002

NOTES: UNLESS OTHERWISE SPECIFIED.
1. ALL RESISTOR VALUES ARE IN OHMS, ±10% 1/4 W.
2. ALL CAPACITOR VALUES ARE IN MICROFARADS.
3. ALL TRANSISTORS ARE 2N3904.
4. PARTIAL REFERENCE DESIGNATOR ARE SHOWN FOR COMPLETE DESIGNATION PREFIX WITH ASSY Nº. (A1A2), EXAMPLE "A1A2C3."
5. C18, C9, C1, CR2, CR3, R25, R30, R32 R35 U3 & U4 ARE OMITTED.
6. * DENOTES FACTORY SELECTED VALUE.
7. VOLTAGES SHOWN WITHOUT TOLERANCES ARE TYPICAL.
8. ALL D.C. VOLTAGES TAKEN WITH NO SIGNALS APPLIED. (DISABLE INTERNAL TIME BASE)

PROPRIETARY STATEMENT
THIS DOCUMENT DISCLOSES INFORMATION AND DATA IN WHICH THE SINGER CO HAS PROPRIETARY RIGHTS NEITHER RECEIPT NOR POSSESSION THEREOF CONFERS OR TRANSFERS ANY RIGHT TO REPRODUCE, USE OR DISCLOSE IN WHOLE OR IN PART EXCEPT BY WRITTEN PERMISSION FROM THE SINGER CO.

C37
CR6
R63
Q9
TP2
U7
LAST REF DES (INCLUSIVE)

LIST OF MATERIALS
QUANTITY REQUIRED | DESCRIPTION | PART NO. | ITEM

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON DIMENSIONS
DECIMAL 2 PLACE ± 3 PLACE ±
ANGULAR ±
MATERIAL —
FINISH —
MODEL NO. FM-10

CONTRACT NO.
DRAWN Gerlach 10-26-69
CHECK
ELEC ENGR 2-25-71
MECH ENGR
APPROVED 3DEC69
N/A 4-003078-008

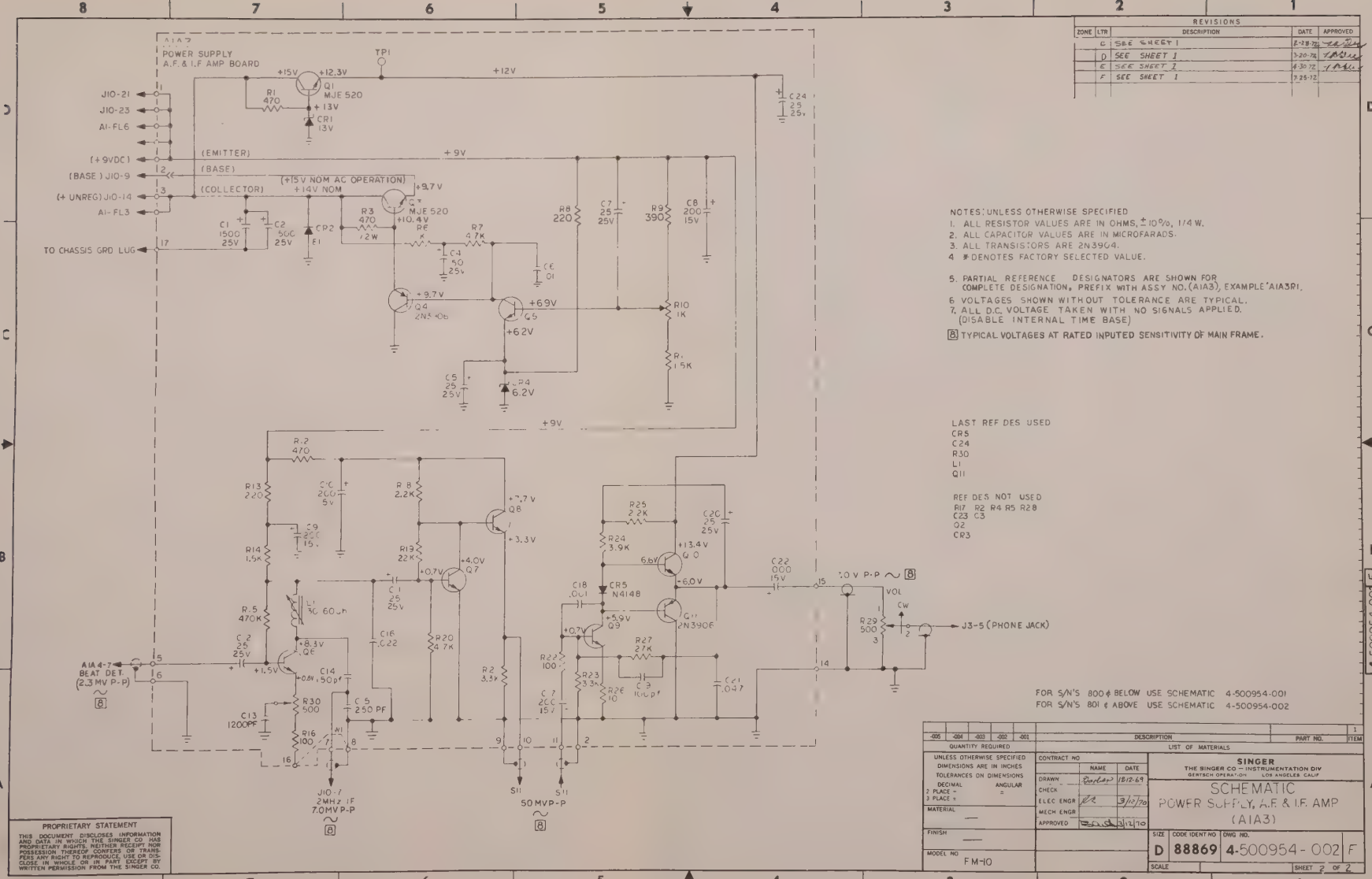
SINGER
THE SINGER CO – METRICS DIV
SEMTECH DEPT. LOS ANGELES, CALIF.

SCHEMATIC
DIVIDER & AUTO LEVEL CONTROL (A1A2)

SIZE D | CODE IDENT NO. 88869 | DWG NO. 4-500953-002 | H
SCALE | SHEET 2 OF 2

4-500953-002 H

Figure 5-2. Divider and Automatic Level Detector (A1A2), Schematic Diagram



REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	C	SEE SHEET 1	2-28-72	
	D	SEE SHEET 1	3-20-72	
	E	SEE SHEET 1	4-30-72	
	F	SEE SHEET 1	7-25-72	

NOTES: UNLESS OTHERWISE SPECIFIED
1. ALL RESISTOR VALUES ARE IN OHMS, ±10%, 1/4 W.
2. ALL CAPACITOR VALUES ARE IN MICROFARADS.
3. ALL TRANSISTORS ARE 2N3904.
4. # DENOTES FACTORY SELECTED VALUE.
5. PARTIAL REFERENCE DESIGNATORS ARE SHOWN FOR COMPLETE DESIGNATION, PREFIX WITH ASSY NO. (A1A3), EXAMPLE 'A1A3R1.
6. VOLTAGES SHOWN WITHOUT TOLERANCE ARE TYPICAL.
7. ALL D.C. VOLTAGE TAKEN WITH NO SIGNALS APPLIED. (DISABLE INTERNAL TIME BASE)
8. TYPICAL VOLTAGES AT RATED INPUTED SENSITIVITY OF MAIN FRAME.

LAST REF DES USED
CR5
C24
R30
L1
Q11

REF DES NOT USED
R17 R2 R4 R5 R28
C23 C3
Q2
CR3

FOR S/N'S 800 & BELOW USE SCHEMATIC 4-500954-001
FOR S/N'S 801 & ABOVE USE SCHEMATIC 4-500954-002

-005	-004	-003	-002	-001	DESCRIPTION	PART NO.	ITEM
QUANTITY REQUIRED					LIST OF MATERIALS		

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES ON DIMENSIONS: DECIMAL 2 PLACE ± 3 PLACE ±; ANGULAR ±. MATERIAL —. FINISH —. MODEL NO FM-10.

CONTRACT NO

	NAME	DATE
DRAWN	Parker	12-12-69
CHECK		
ELEC ENGR	RR	3/10/70
MECH ENGR		
APPROVED		3/12/70

SINGER
THE SINGER CO — INSTRUMENTATION DIV
GENTSCH OPERATION LOS ANGELES CALIF

SCHEMATIC
POWER SUPPLY, A.F. & I.F. AMP
(A1A3)

SIZE	CODE IDENT NO	DWG NO.	
D	88869	4-500954-002	F

SCALE — SHEET 2 OF 2

4-500954-002 F1

PROPRIETARY STATEMENT
THIS DOCUMENT DISCLOSES INFORMATION AND DATA IN WHICH THE SINGER CO HAS PROPRIETARY RIGHTS. NEITHER RECEIPT NOR POSSESSION THEREOF CONFERS USE TRANSFERS ANY RIGHT TO REPRODUCE, USE OR DISCLOSE IN WHOLE OR IN PART EXCEPT BY WRITTEN PERMISSION FROM THE SINGER CO.

Figure 5-3. Power Supply, AF and IF Amplifer (A1A3); Schematic Diagram

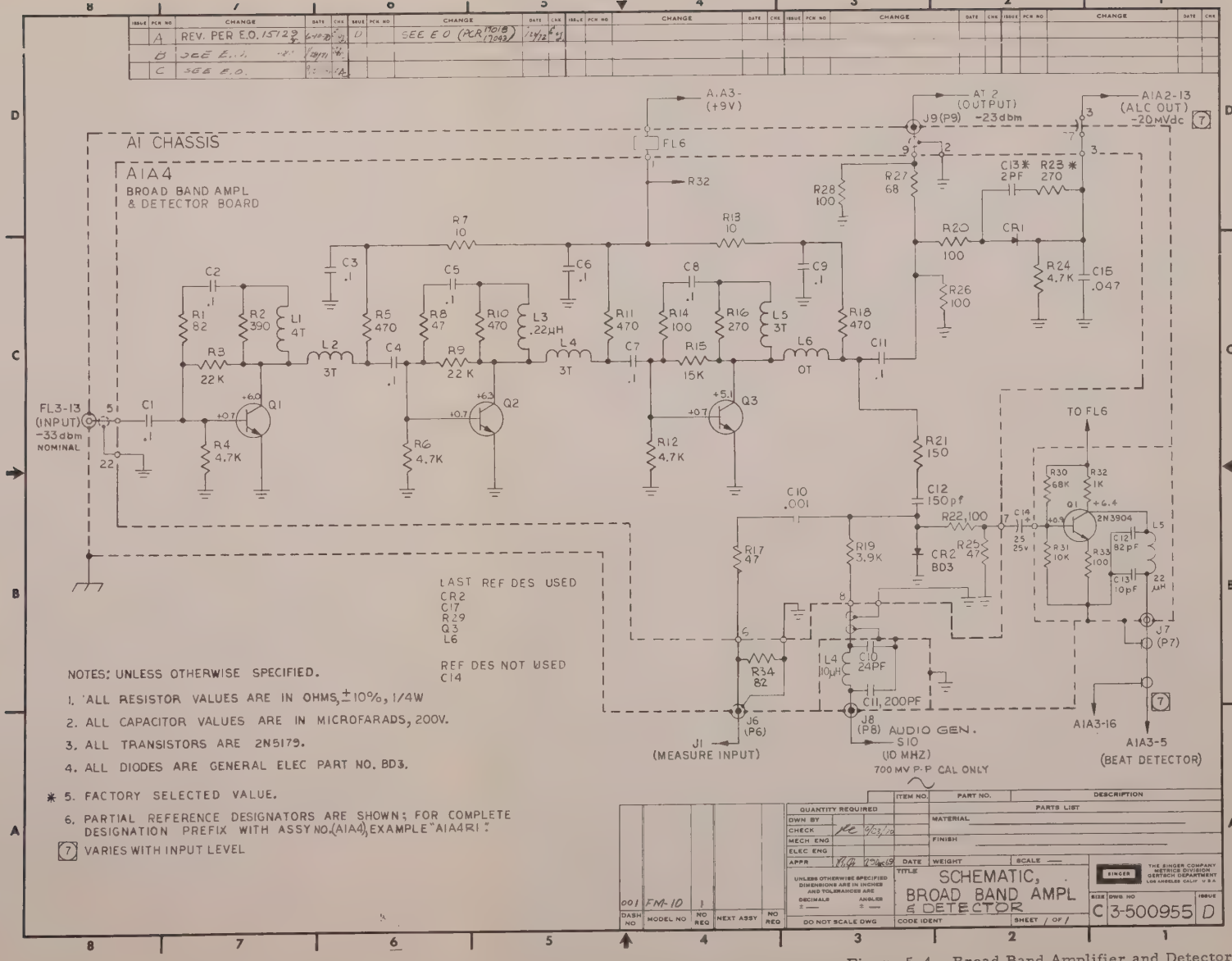


Figure 5-4. Broad Band Amplifier and Detector (A1A4), Schematic Diagram

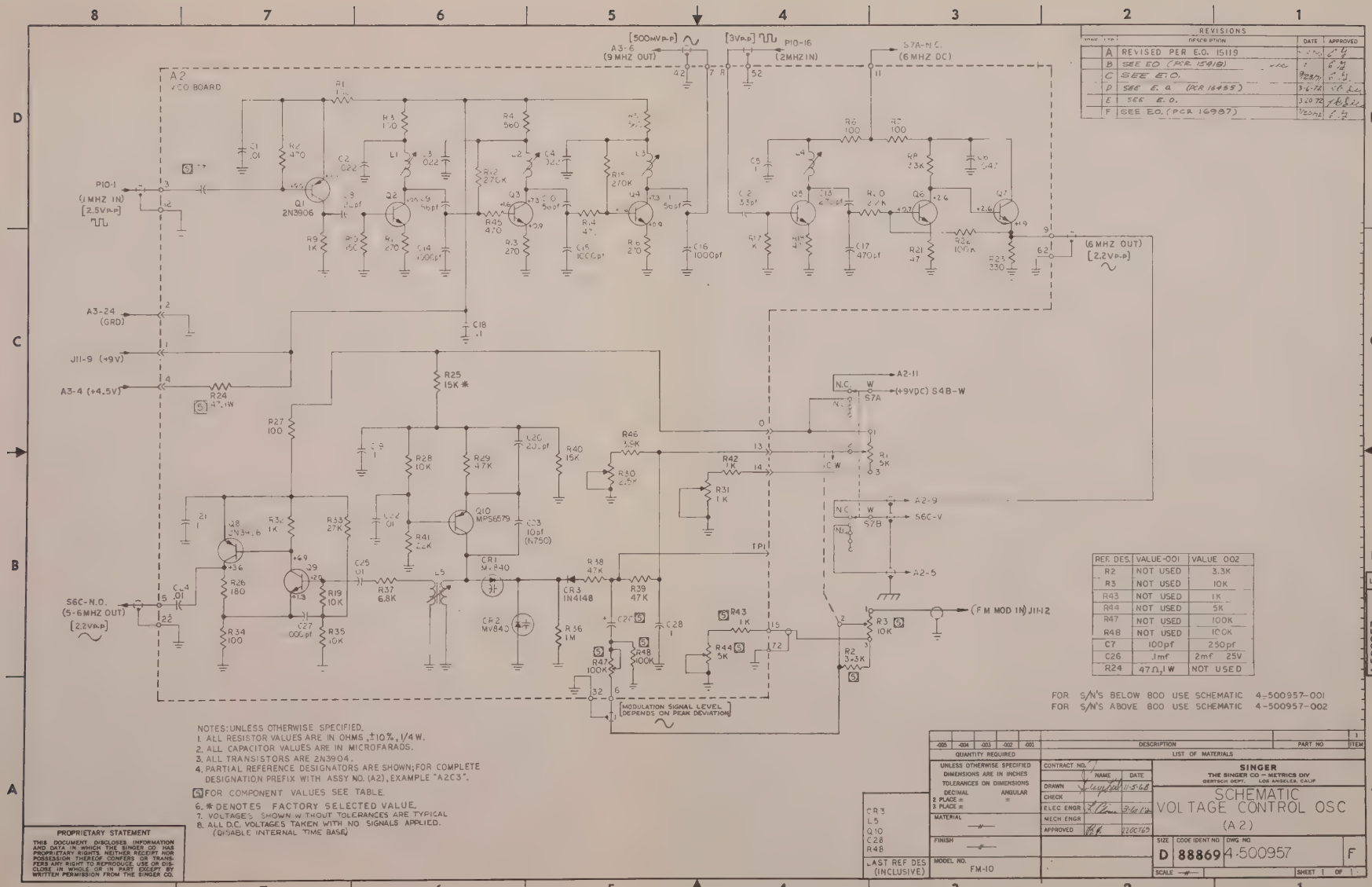


Figure 5-5. VCO and 6- and 9-MHz Generators (A2), Schematic Diagram

5-11/5-12

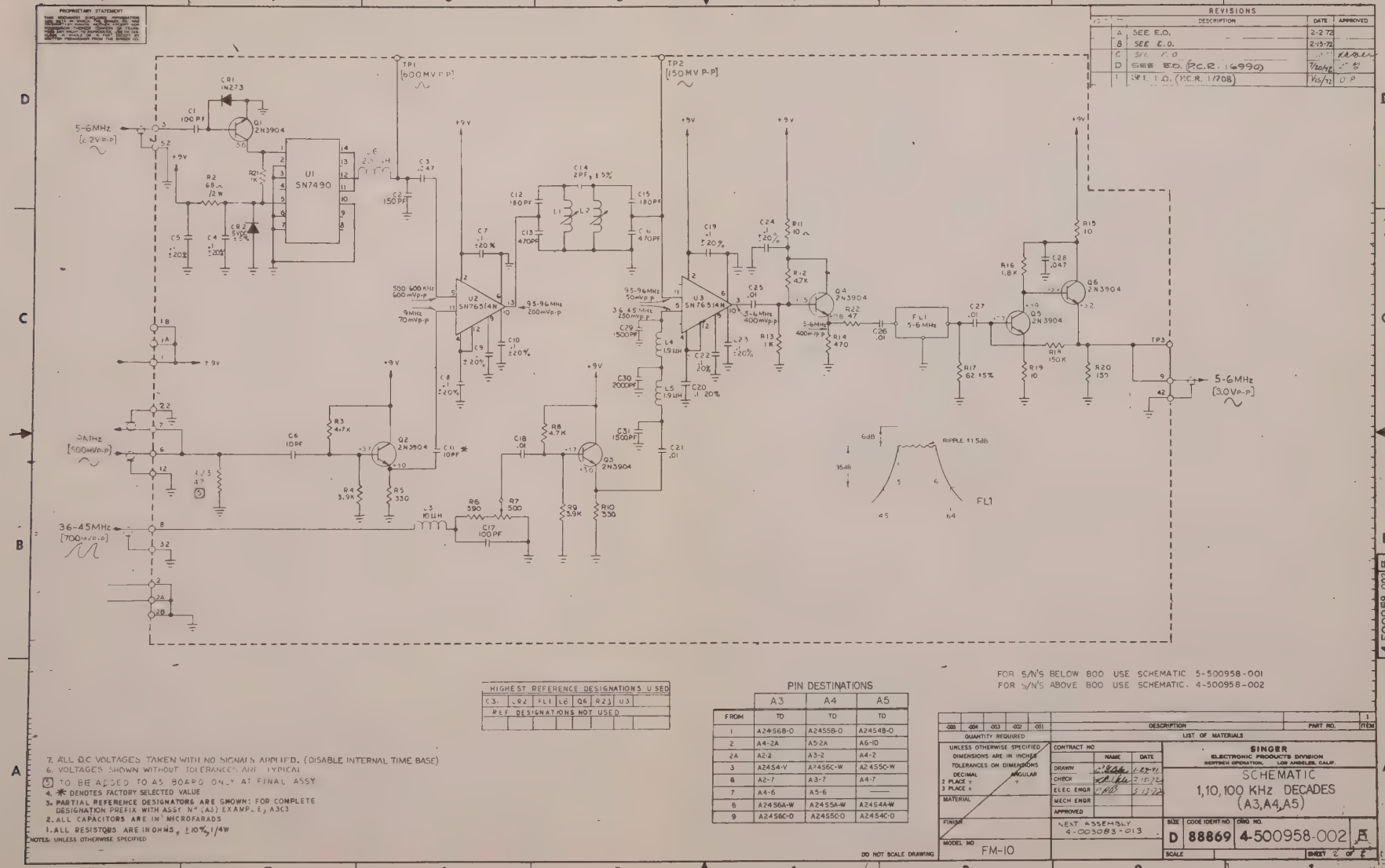


Figure 5-6. 1, 10, and 100 kHz Decades (A3, A4, A5), Schematic Diagram

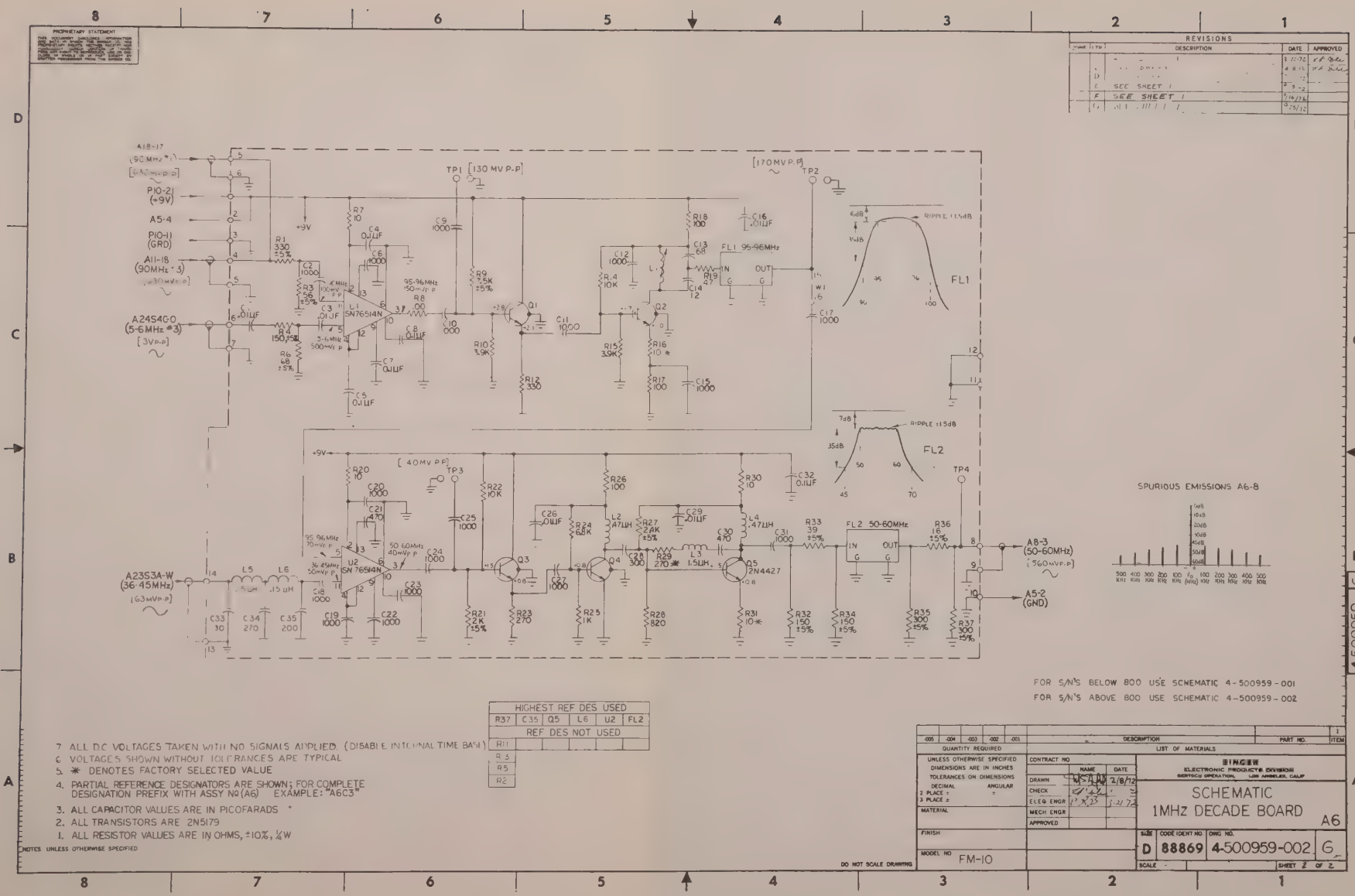


Figure 5-7. 1 MHz Decade (A6), Schematic Diagram

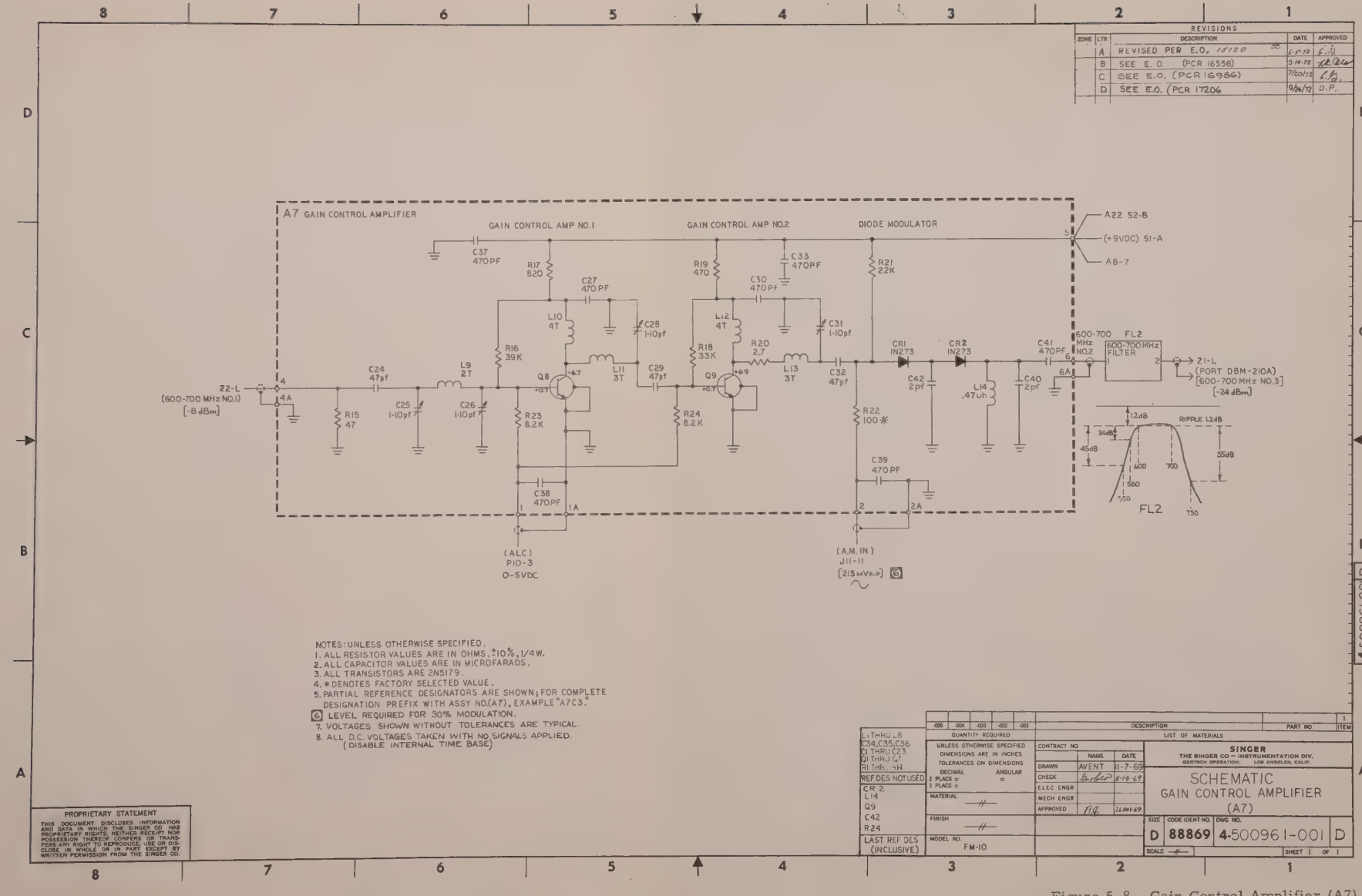
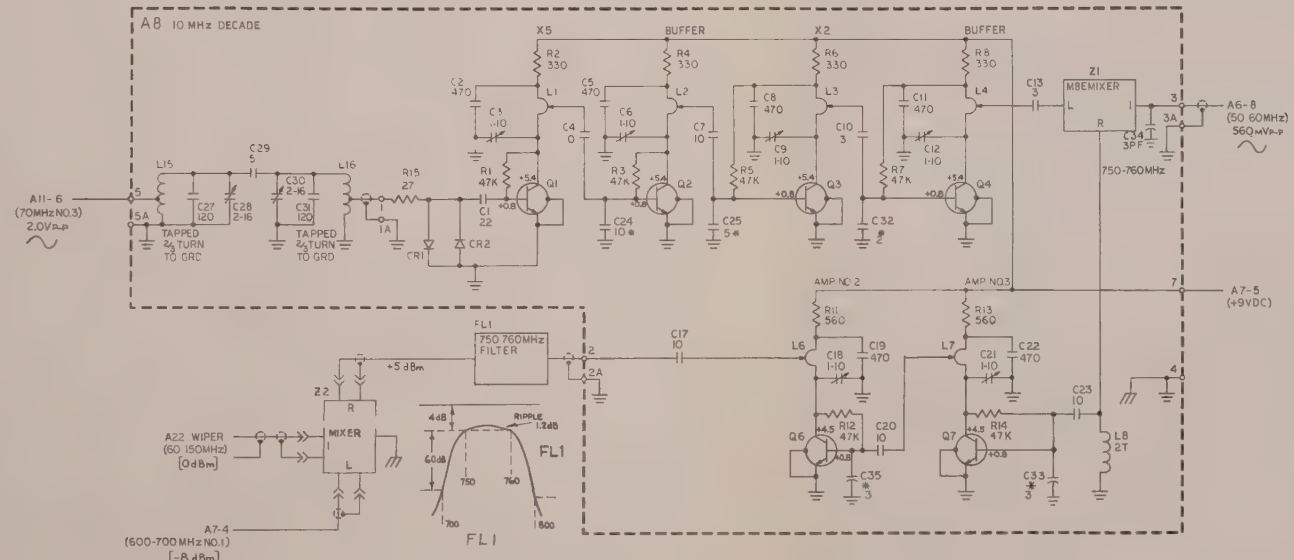


Figure 5-8. Gain Control Amplifier (A7), Schematic Diagram

5-17/5-18



NOTES: UNLESS OTHERWISE SPECIFIED.
1. ALL RESISTOR VALUES ARE IN OHMS, ±10%, 1/4W.
2. ALL CAPACITOR VALUES ARE IN PICOFARADS.
3. ALL DIODES ARE IN273.
4. ALL TRANSISTORS ARE 2N5179.
5. * DENOTES FACTORY SELECTED VALUE.
6. PARTIAL REFERENCE DESIGNATORS ARE SHOWN; FOR COMPLETE DESIGNATION PREFIX WITH ASSY NO.(A8), EXAMPLE "A8C3".
7. VOLTAGES SHOWN WITHOUT TOLERANCES ARE TYPICAL.
8. ALL D.C. VOLTAGES TAKEN WITH NO SIGNALS APPLIED. (DISABLE INTERNAL TIME BASE)

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	A	REVISED PER E.O. 15126	6-19-70	C.H.
	B	SEE EO (16032)	3-7-72	
	C	SEE E.O (16879)	6-9-72	C.H.
	D	SEE E.O. (17267)	9/25/72	D.P.

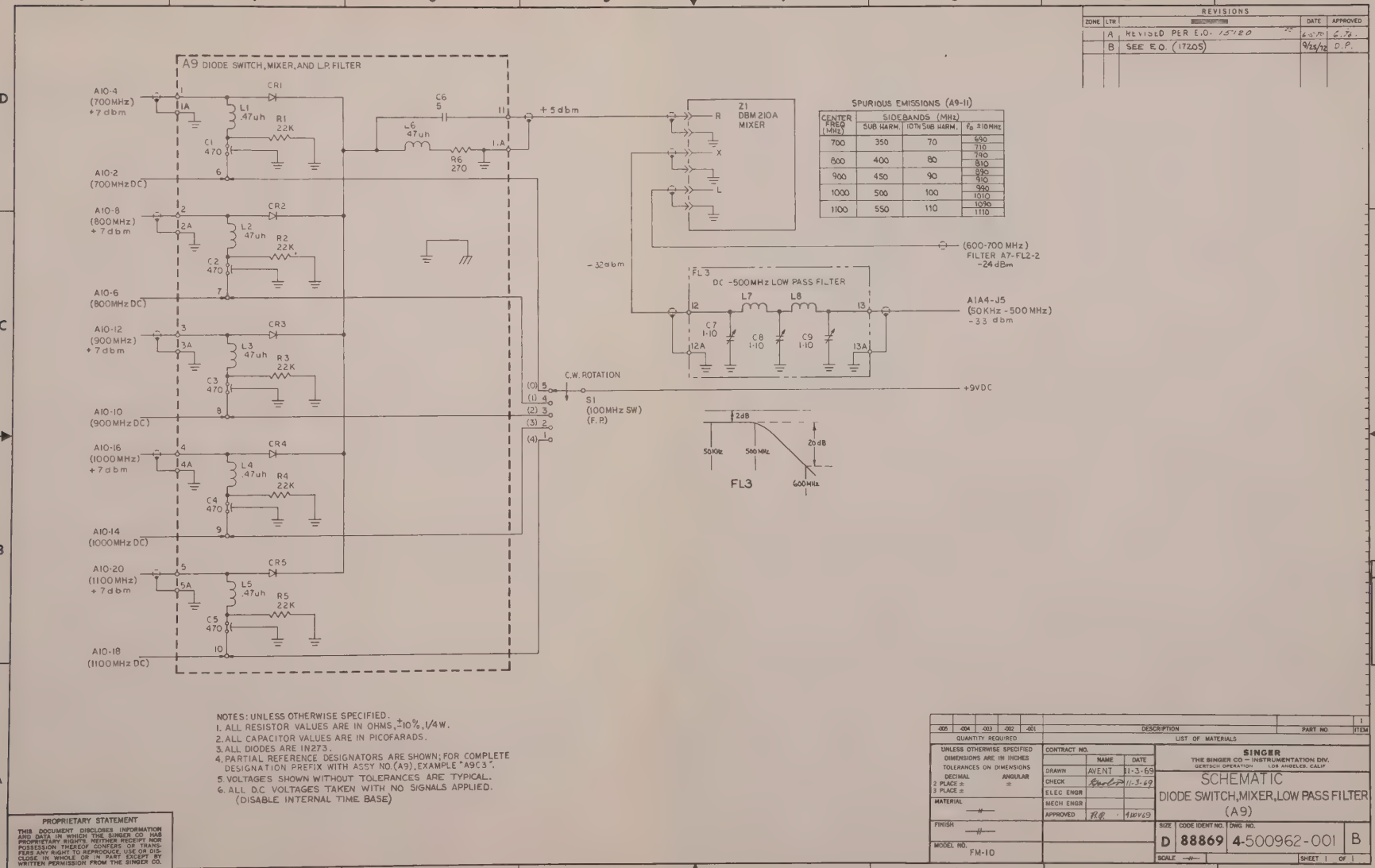
QUANTITY REQUIRED	DESCRIPTION / PART NO.	ITEM
-005 -004 -003 -002 -001	LIST OF MATERIALS	

R9,10 Q5 C26,14,15,16 L9,10,11,12,13,14,5	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON DIMENSIONS DECIMAL ANGULAR 2 PLACE ± ± 3 PLACE ±	CONTRACT NO.	SINGER THE SINGER CO — INSTRUMENTATION DIV. SENTECH OPERATION. LOS ANGELES, CALIF.
REF DES NOT USED CR2 FL1 L16 - 22 Q7 C35 R17	MATERIAL — FINISH —	NAME / DATE: DRAWN AVENT 11-6-69; CHECK Boyle 11-16-69; ELEC ENGR 2-25-72; MECH ENGR; APPROVED R.G. 2/16/69	SCHEMATIC 10 MHz DECADE (A8)
LAST REF DES (INCLUSIVE)	MODEL NO FM-10		SIZE D; CODE IDENT NO 88869; DWG NO 4-500960-001 D; SCALE —; SHEET OF

PROPRIETARY STATEMENT
THIS DOCUMENT DISCLOSES INFORMATION AND DATA IN WHICH THE SINGER CO HAS PROPRIETARY RIGHTS. NEITHER RECEIPT NOR POSSESSION THEREOF CONFERS OR TRANSFERS ANY RIGHT TO REPRODUCE, USE OR DISCLOSE WHOLE OR IN PART EXCEPT BY WRITTEN PERMISSION FROM THE SINGER CO.

4-500960-001 D

Figure 5-9. 10 MHz Decade (A8), Schematic Diagram



SPURIOUS EMISSIONS (A9-11)

CENTER FREQ (MHz)	SIDEBANDS (MHz) SUB HARM.	10TH SUB HARM.	$f_0 \pm 10$ MHz
700	350	70	690
			710
800	400	80	790
			810
900	450	90	890
			910
1000	500	100	990
			1010
1100	550	110	1090
			1110

REVISIONS

ZONE	LTR		DATE	APPROVED
	A	REVISED PER E.O. 15120	6/5/72	D.P.
	B	SEE E.O. (17205)	9/25/72	D.P.

NOTES: UNLESS OTHERWISE SPECIFIED.
1. ALL RESISTOR VALUES ARE IN OHMS, ±10%, 1/4W.
2. ALL CAPACITOR VALUES ARE IN PICOFARADS.
3. ALL DIODES ARE IN273.
4. PARTIAL REFERENCE DESIGNATORS ARE SHOWN; FOR COMPLETE DESIGNATION PREFIX WITH ASSY NO.(A9), EXAMPLE "A9C3".
5. VOLTAGES SHOWN WITHOUT TOLERANCES ARE TYPICAL.
6. ALL D.C VOLTAGES TAKEN WITH NO SIGNALS APPLIED. (DISABLE INTERNAL TIME BASE)

PROPRIETARY STATEMENT
THIS DOCUMENT DISCLOSES INFORMATION AND DATA IN WHICH THE SINGER CO HAS PROPRIETARY RIGHTS. NEITHER RECEIPT NOR POSSESSION THEREOF CONFERS OR TRANSFERS ANY RIGHT TO REPRODUCE, USE OR DISCLOSE, IN WHOLE OR IN PART, EXCEPT BY WRITTEN PERMISSION FROM THE SINGER CO.

LIST OF MATERIALS

ITEM	PART NO.	DESCRIPTION	QUANTITY REQUIRED
1			

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON DIMENSIONS
DECIMAL ANGULAR
2 PLACE ±
3 PLACE ±
MATERIAL —//—
FINISH —//—
MODEL NO. FM-10

CONTRACT NO.

	NAME	DATE
DRAWN	AVENT	11-3-69
CHECK		11-3-69
ELEC ENGR		
MECH ENGR		
APPROVED		11/4/69

SINGER
THE SINGER CO — INSTRUMENTATION DIV.
GERTSCH OPERATION LOS ANGELES, CALIF.

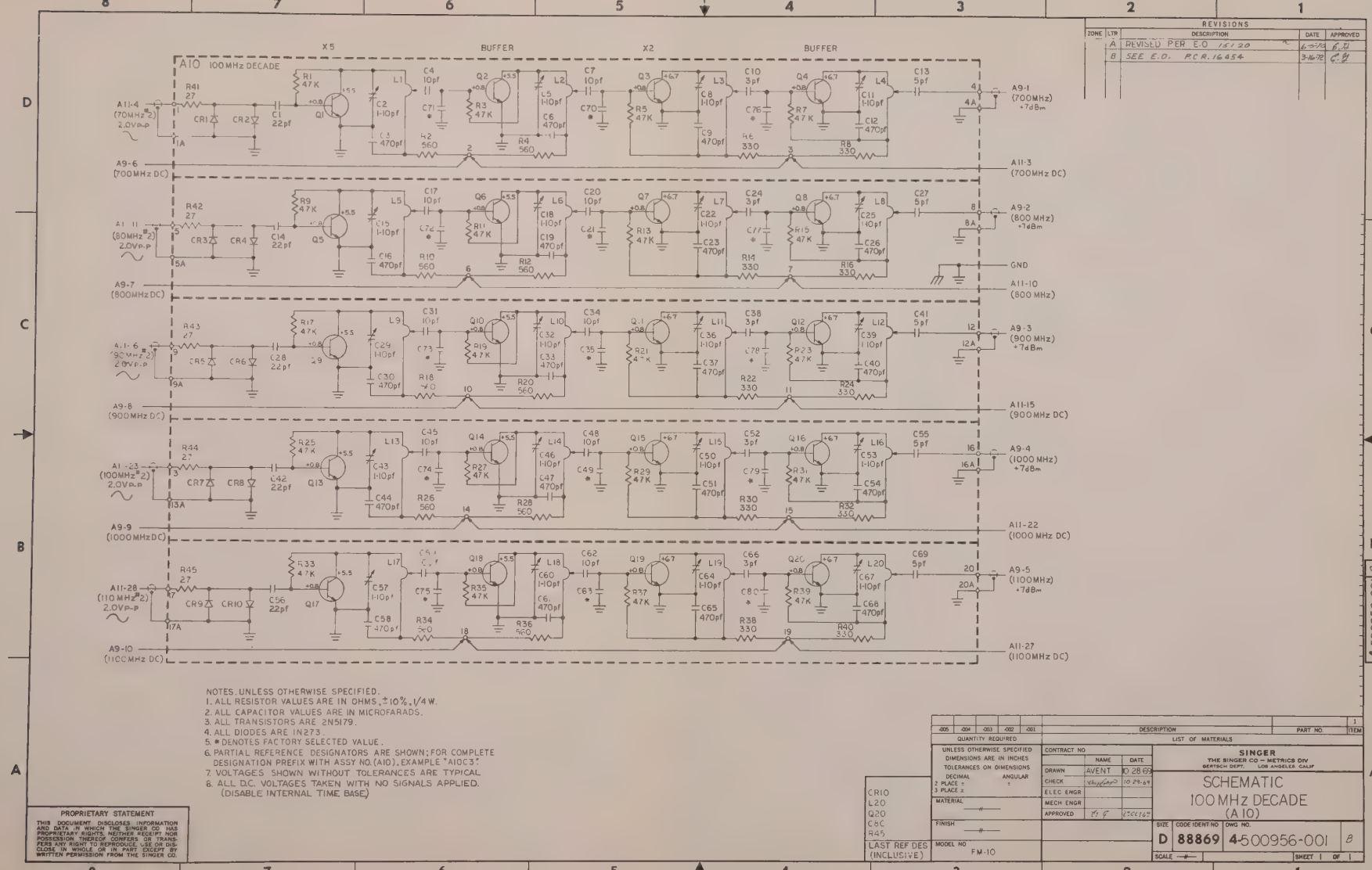
SCHEMATIC
DIODE SWITCH, MIXER, LOW PASS FILTER
(A9)

SIZE	CODE IDENT NO.	DWG NO.	
D	88869	4-500962-001	B

SCALE —//— SHEET 1 OF 1

4-500962-001 B

Figure 5-10. Diode Switch (A9), Schematic Diagram



NOTES: UNLESS OTHERWISE SPECIFIED.
1. ALL RESISTOR VALUES ARE IN OHMS, ±10%, 1/4 W.
2. ALL CAPACITOR VALUES ARE IN MICROFARADS.
3. ALL TRANSISTORS ARE 2N5179.
4. ALL DIODES ARE IN273.
5. * DENOTES FACTORY SELECTED VALUE.
6. PARTIAL REFERENCE DESIGNATORS ARE SHOWN; FOR COMPLETE DESIGNATION PREFIX WITH ASSY NO. (A10), EXAMPLE "A10C3".
7. VOLTAGES SHOWN WITHOUT TOLERANCES ARE TYPICAL.
8. ALL D.C. VOLTAGES TAKEN WITH NO SIGNALS APPLIED. (DISABLE INTERNAL TIME BASE)

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	A	REVISED PER E.O 16120	6-5-72	R.M
	B	SEE E.O. P.C.R. 16454	3-16-72	C.B

PROPRIETARY STATEMENT

THIS DOCUMENT DISCLOSES INFORMATION AND DATA IN WHICH THE SINGER CO. HAS PROPRIETARY RIGHTS. NEITHER RECEIPT NOR POSSESSION THEREOF CONFERS OR TRANSFERS ANY RIGHT TO REPRODUCE, USE OR DISCLOSE IN WHOLE OR IN PART EXCEPT BY WRITTEN PERMISSION FROM THE SINGER CO.

-005	-004	-003	-002	-001	DESCRIPTION	PART NO.	ITEM
QUANTITY REQUIRED					LIST OF MATERIALS		

CR10
L20
Q20
C6C
R45
LAST REF DES (INCLUSIVE)

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON DIMENSIONS
DECIMAL ANGULAR
2 PLACE ± ±
3 PLACE ±
MATERIAL —
FINISH —
MODEL NO FM-10

CONTRACT NO	NAME	DATE
DRAWN	AVENT	10 28 69
CHECK	[illegible]	10 29 69
ELEC ENGR		
MECH ENGR		
APPROVED	[illegible]	[illegible]

SINGER
THE SINGER CO — METRICS DIV
GERTSCH DEPT. LOS ANGELES, CALIF.

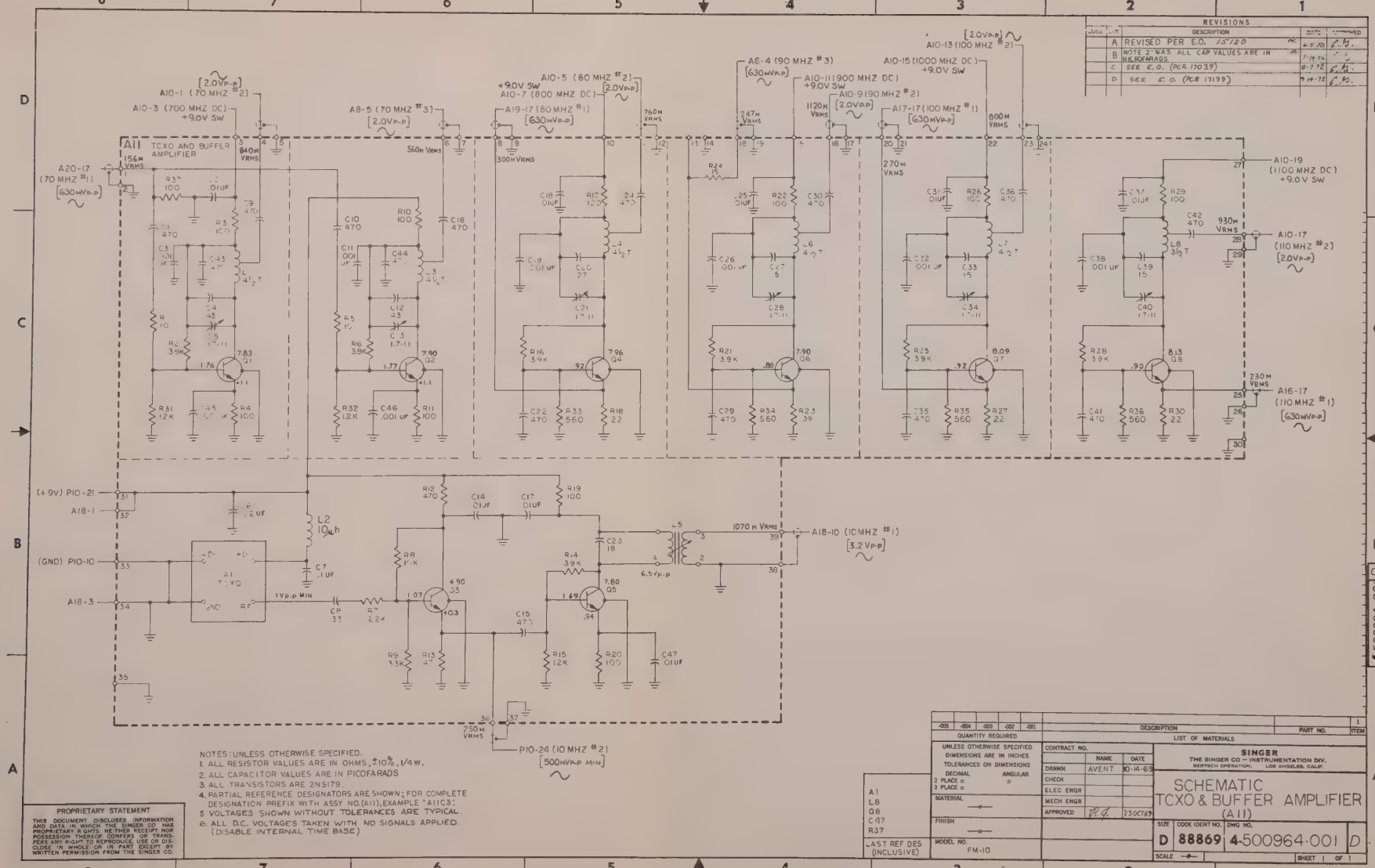
SCHEMATIC
100 MHz DECADE
(A10)

SIZE	CODE IDENT NO	DWG NO.	
D	88869	4-500956-001	B

SCALE — SHEET 1 OF 1

4-500956-001 B

Figure 5-11. 100 MHz Decade (A10), Schematic Diagram



NOTES: UNLESS OTHERWISE SPECIFIED.
1. ALL RESISTOR VALUES ARE IN OHMS, ±10%, 1/4W.
2. ALL CAPACITOR VALUES ARE IN PICOFARADS
3. ALL TRANSISTORS ARE 2N5179.
4. PARTIAL REFERENCE DESIGNATORS ARE SHOWN; FOR COMPLETE DESIGNATION PREFIX WITH ASSY NO.(A11), EXAMPLE "A11C3".
5. VOLTAGES SHOWN WITHOUT TOLERANCES ARE TYPICAL.
6. ALL D.C. VOLTAGES TAKEN WITH NO SIGNALS APPLIED. (DISABLE INTERNAL TIME BASE)

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
A	REVISED PER E.O. 15720	6-5-70	
B	NOTE 2 WAS ALL CAP VALUES ARE IN MICROFARADS	7-14-70	
C	SEE E.O. (PCR 17039)	8-7-72	
D	SEE E.O. (PCR 17199)	9-14-72	

PROPRIETARY STATEMENT
THIS DOCUMENT DISCLOSES INFORMATION AND DATA IN WHICH THE SINGER CO. HAS PROPRIETARY RIGHTS. NEITHER RECEIPT NOR POSSESSION THEREOF CONFERS OR TRANSFERS ANY RIGHT TO REPRODUCE, USE OR DISCLOSE IN WHOLE OR IN PART EXCEPT BY WRITTEN PERMISSION FROM THE SINGER CO.

A1
LB
Q8
C47
R37
LAST REF DES (INCLUSIVE)

-005	-004	-003	-002	-001	DESCRIPTION	PART NO.	ITEM
QUANTITY REQUIRED					LIST OF MATERIALS		

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON DIMENSIONS
DECIMAL ANGULAR
2 PLACE ± ±
3 PLACE ±
MATERIAL
FINISH
MODEL NO. FM-10

CONTRACT NO.	NAME	DATE
DRAWN	AVENT	10-14-69
CHECK		
ELEC ENGR		
MECH ENGR		
APPROVED		23OCT69

SINGER
THE SINGER CO — INSTRUMENTATION DIV.
GENTECH OPERATION, LOS ANGELES, CALIF.

SCHEMATIC
TCXO & BUFFER AMPLIFIER
(A11)

SIZE	CODE IDENT NO.	DWG NO.	
D	88869	4-500964-001	D

SCALE — SHEET 1 OF 1

4-500964-001-D

Figure 5-12. TCXO and Buffer Amplifier (A11), Schematic Diagram

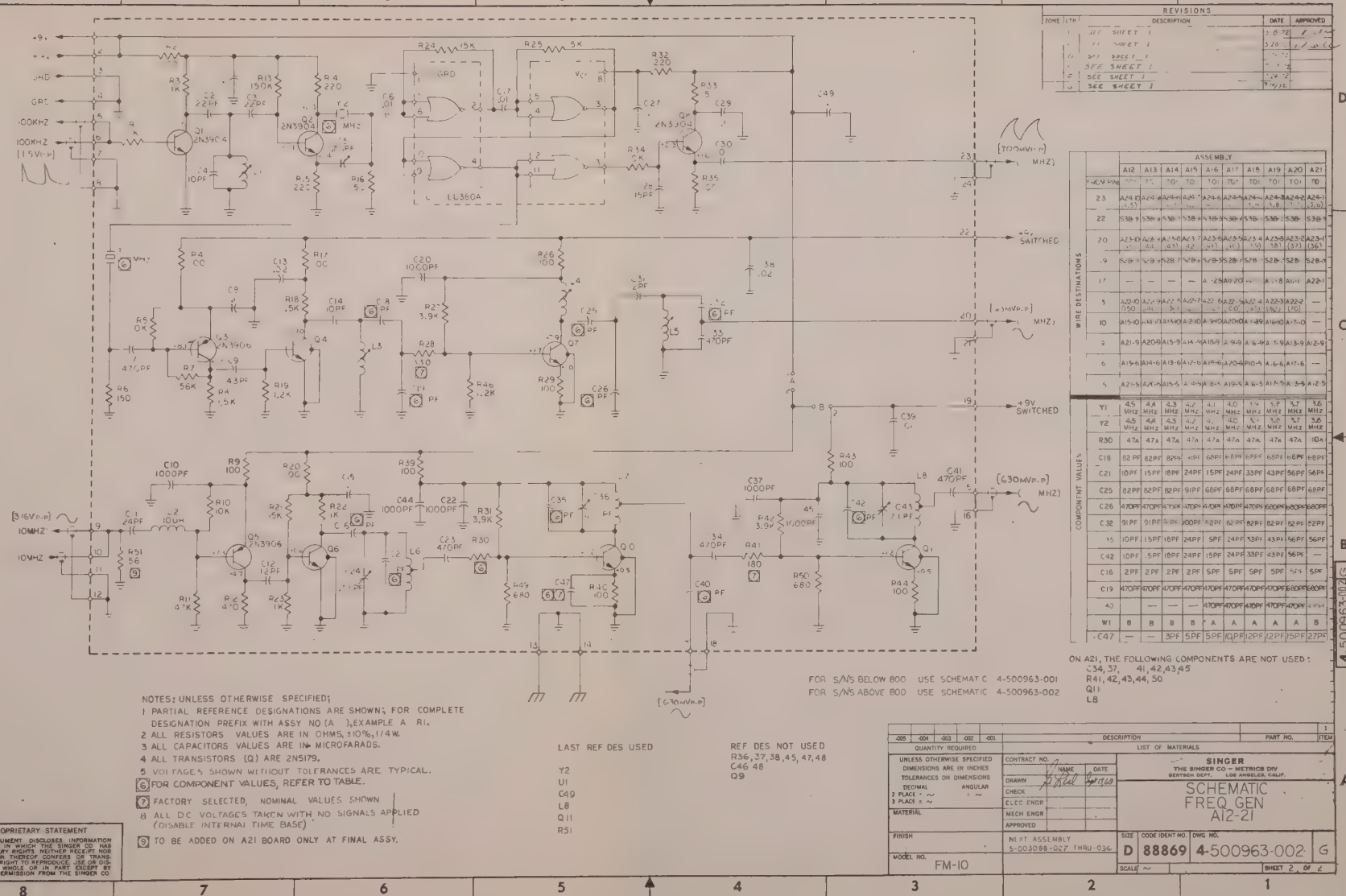


Figure 5-13. Frequency Generator (A12 - A21), Schematic Diagram

5-27/5-28

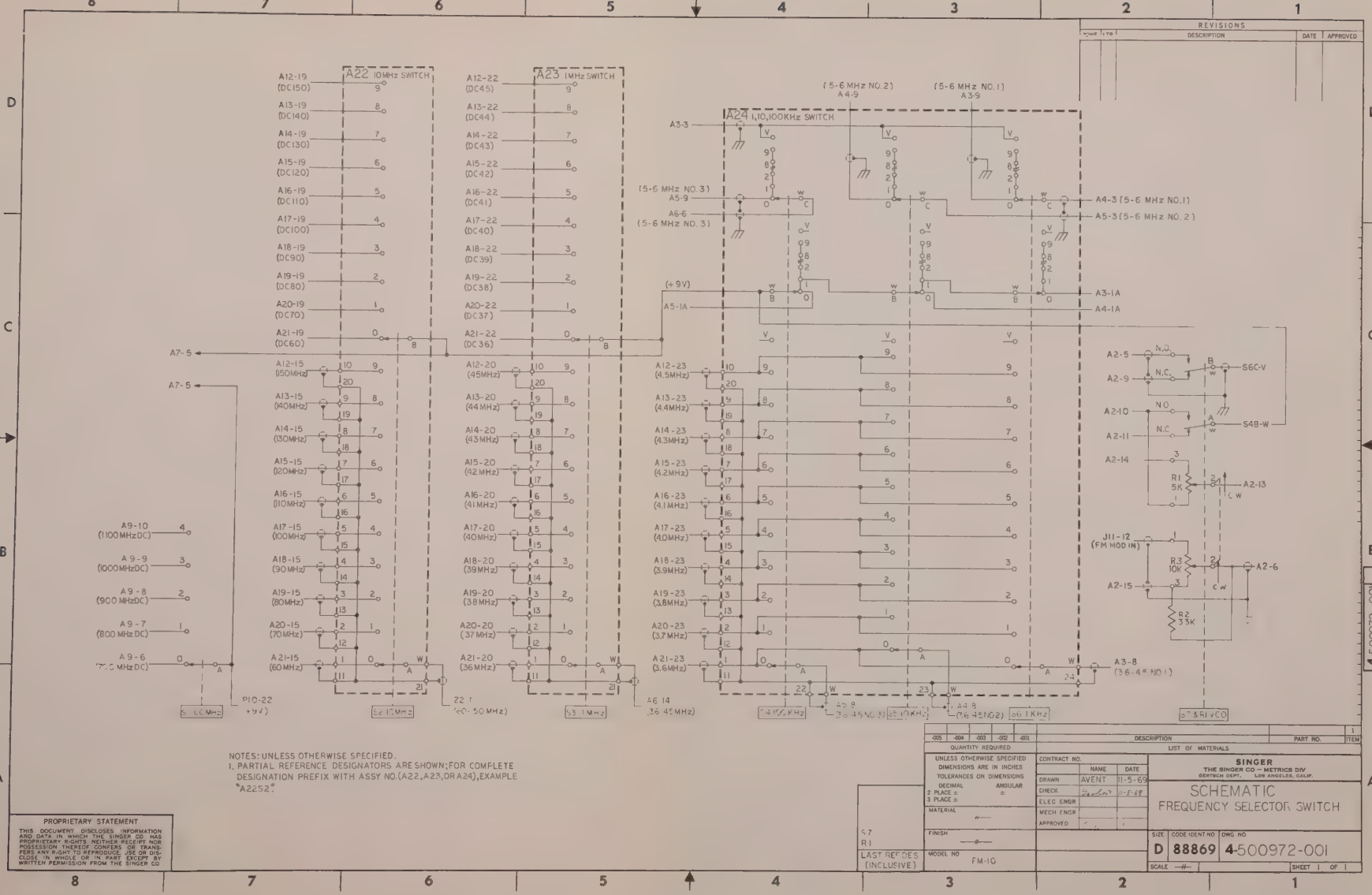


Figure 5-14. Frequency Selector Switches (S1, A22 - A24), Schematic Diagram

SECTION VI

PARTS LIST

FM10 - MAINFRAME ASSEMBLY

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
A1	Left-Hand Module Assembly	003097-006	Singer	–	1
A2	VCO, 6 & 9 MHz Gen Assembly	003082-005	Singer	–	1
A3	1kHz Decade Assembly	003083-013	Singer	–	1
A4	10 kHz Decade Assembly	003083-013	Singer	–	1
A5	100kHz Decade Assembly	003083-013	Singer	–	1
A6	1 MHz Decade Assembly	003084-007	Singer	–	1
A7-A8	Sub Assembly	003243-001	Singer	–	2
A9-A10	Sub Assembly	003241-001	Singer	–	2
A11	TCXO & Buffer Amp Assembly	003089-005	Singer	–	1
A12	4.5, 45, & 150 MHz Gen Assembly	003088-027	Singer	–	1
A13	4.4, 44, & 140 MHz Gen Assembly	003088-028	Singer	–	1
A14	4.3, 43, & 130 MHz Gen Assembly	003088-029	Singer	–	1
A15	4.2, 42, & 120 MHz Gen Assembly	003088-030	Singer	–	1
A16	4.1, 41, & 110 MHz Gen Assembly	003088-031	Singer	–	1
A17	4.0, 40, & 100 MHz Gen Assembly	003088-032	Singer	–	1
A18	3.9, 39, & 90 MHz Gen Assembly	003088-033	Singer	–	1
A19	3.8, 38, & 80 MHz Gen Assembly	003088-034	Singer	–	1
A20	3.7, 37, & 70 MHz Gen Assembly	003088-035	Singer	–	1
A21	3.6, 36, & 60 MHz Gen Assembly	003088-036	Singer	–	1
A22	10 MHz Switch Assembly (S2)	003105-005	Singer	–	1
A23	1 MHz Switch Assembly (S3)	003105-006	Singer	–	1
A24	100, 10, & 1kHz Switch Assembly (S4, S5 & S6)	003106-005	Singer	–	1
J1-J10	Not used				0
J11	Connector, 16 Pin	910072-001	Amphenol	26-190-16	1
MP1	Dial Assy	301930-001	Singer	–	1
MP2, MP3	Dial Assy	301930-002	Singer	–	2

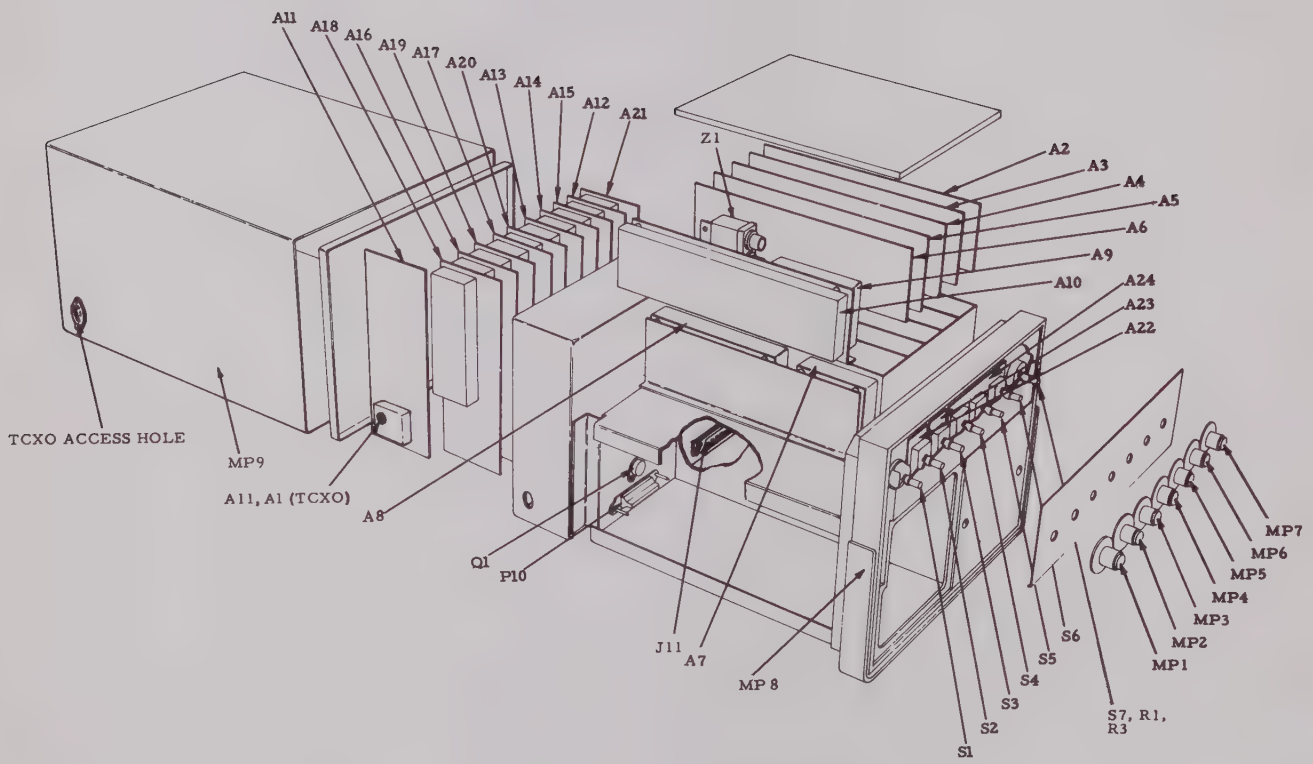


Figure 6-1. Exploded Isometric Diagram, Mainframe (A1 Removed)

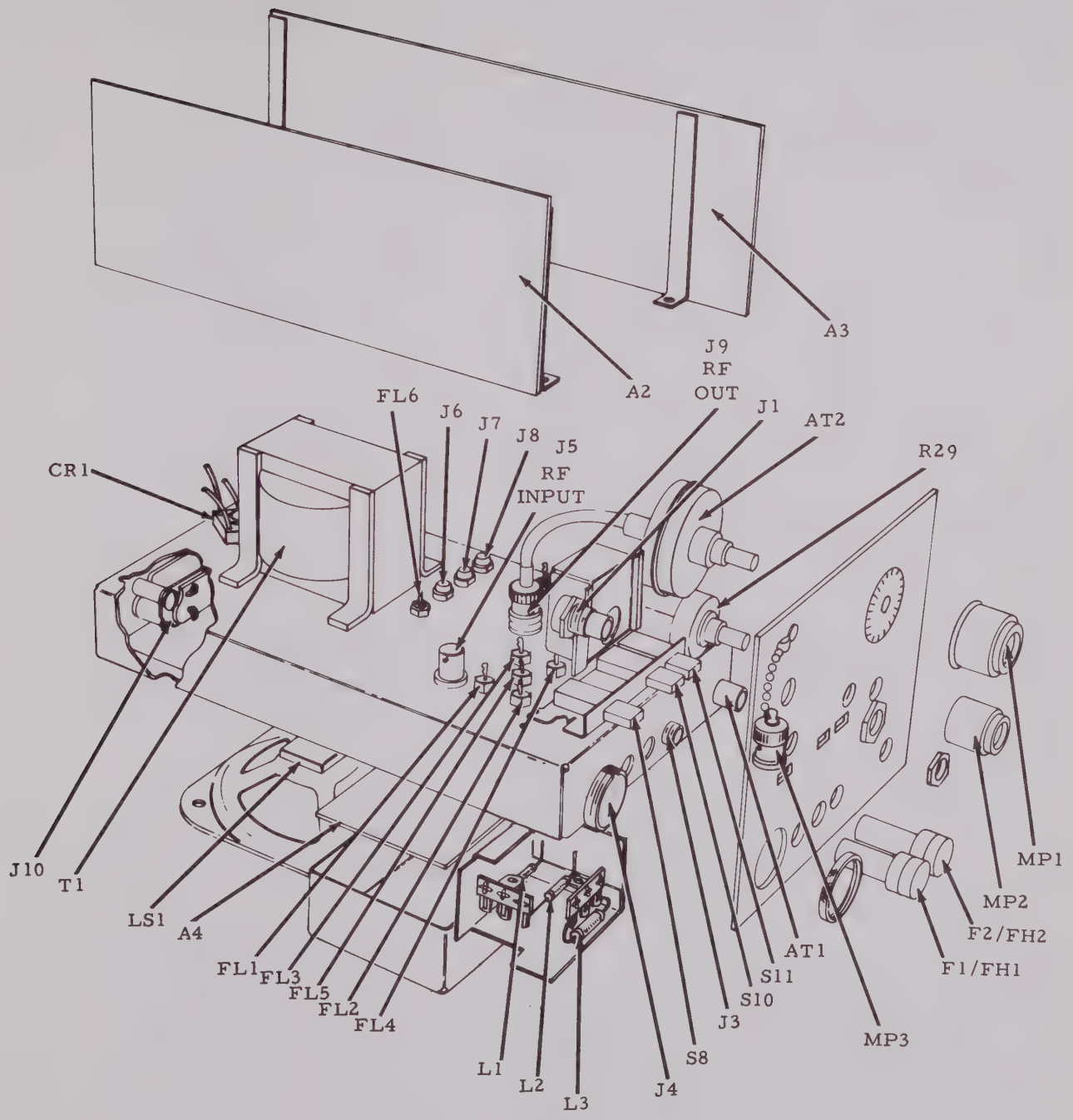


Figure 6-2. Exploded Isometric Diagram Assembly A1, Left-Hand Module

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
MP4 thru MP6	Dial Assembly	301930-005	Singer	—	3
MP7	Dial Assembly	302109-001	Singer	—	1
MP8	Handle Assembly	003096-001	Singer	—	1
MP9	Case	002774-001	Singer	—	1
P1-P9	Not used				
P10	Connector, 24 Pin	910071-002	Amphenol	26-159-24	1
Q1	Transistor	958039-001	Motorola	2N3055	1
R1	Resistor, Variable, 1k, Part of S7 Assy				1
R2	Resistor, 3.3k	945000-043	Allen-Bradley	Type CB	1
R3	Resistor, Variable, 10k, Part of S7 Assy				1
R4	Resistor, 470 ohm	945000-033	Allen-Bradley	Type CB	1
S1-S6	Not used				
S7	VCO Switch Assy (Contains R1 and R3)	004714-001	Singer	—	1

LEFT-HAND MODULE ASSEMBLY A1

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
A1	Not used				0
A2	Divider & Auto Control Assembly	003078-009	Singer		1
A3	Power Supply, AF & IF Amplifier	003079-007	Singer		1
A4	Broadband Amp & Detector Assembly	003080-005	Singer		1
AT1	Attenuator, Pad, RFA-10A	001355-005	Singer		1
AT2	Attenuator, Variable	103576-001	Singer		1
C1, C2	Capacitor, Standoff, 1000 pF	900044-002	Allen-Bradley	SS5D-102W	2
C3, C6	Capacitor, Disc, 470 pF	900105-001	Sprague	30GA-T47	2
C4	Capacitor, .001 μF	900012-002	Erie	86125U102P	1
C5	Capacitor, .5 μF	900006-001	SEI Mfg.	1143	1
C7	Capacitor, Feed-through .001 μF	900038-001	Allen-Bradley	FB2B-102W	1
C8, C9	Not used				0
C10	Capacitor, 24 pF	900003-014	Electromotive	DM-15	1
C11	Capacitor, 200 pF	900003-037	Electromotive	DM-15	1
C12	Capacitor, 82 pF	900003-028	Electromotive	DM-15	1
C13	Capacitor, 10 pF	900003-008	Electromotive	DM-15	1
C14	Capacitor, 25 μF, 25V	900039-001	Gen. Inst. Corp. Capacitor Grp.	984-2203	1

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
CR1	Bridge Rectifier	913025-001	Varo	W601	1
DS1	Lamp	925007-002	Mura	L-10/20	1
DS2	Lamp	925007-003	Mura	L-10/20	1
F1	Fuse, 3/4A	924000-017	Bussman	MDL	1
F2	Fuse, 4A	924000-029	Bussman	MDL	1
FH1, FH2	Fuseholder	924001-007	Littlefuse	341001	2
FL1, FL2	Filter	900108-001	Erie Elect.	1201-050	2
FL3-FL6	Filter	919011-004	Erie Elect.	1202-051	4
J1, J5, J9	Connector, BNC	910043-001	Kings Elect.	KC-19-93	3
J2	Connector	Part of AT1			
J3	Connector	910077-001	Switchcraft	L112A	1
J4	Connector	910088-001	Amphenol	91PC4M	1
J6-J8	Connector	910026-001	Switchcraft	3C1054A	3
J10	Connector	910072-002	Amphenol	26-190-24	1
L1, L2	Choke, 3.9 µH	906002-008	J.W.Miller	70F396AI	2
L3	Choke, 1.8 µH	906009-001	J.W.Miller	–	1
L4	Choke, RF, 10 µH	906003-025	Nytronics	DD-10.0	1
L5	Choke, RF, 22 µH	906003-029	Nytronics	DD-22.0	1
LS1	Loudspeaker	936001-001	Quam	597-1	1
MP1	Knob, Assy	004362-001	Singer	–	1
MP2	Knob	935002-002	Buckeye	RSSN-70-2	1
MP3	Cap. BNC Connector	910118-001	Dage Electric	366-1	1
Q1	Transistor	958000-101	Motorola	2N3904	1
R1-R28	Not Used				0
R29	Resistor, Variable 500 ohm	945009-001	Mallory	MTC 13L4	1
R30	Resistor, 68 k	945000-059	Allen-Bradley	Type CB	1
R31	Resistor, 10 k	945000-049	Allen-Bradley	Type CB	1
R32	Resistor, 1 k	945000-037	Allen-Bradley	Type CB	1
R33	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R34	Resistor, 82 ohm	945000-024	Allen-Bradley	Type CB	1
S1-S7	Not Used				0
S8, S10, S11	Switch Assembly	951024-001	Switchcraft	65047-206	1
S9	Not Used				0
T1	Transformer, Power	402835-001	Singer	–	1

DIVIDER AND AUTOMATIC LEVEL CONTROL ASSEMBLY A1A2

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
C1	Capacitor, .01 μF	900001-001	Amperex	C280AE	1
C2	Capacitor, 100 pF	900003-030	Electromotive	DM15	1
C3	Capacitor, .1 μF	900001-013	Amperex	C280AE	1
C4	Capacitor, .047 μF	90001-009	Amperex	C280AE	1
C5	Capacitor, 47 pF	900003-021	Electromotive	DM15	1
C6	Capacitor, .47 μF	900001-021	Amperex	C280AE	1
C7	Not Used				1
C8	Capacitor, 100 pF	900003-030	Electromotive	DM15	1
C9	Not Used				0
C10, C11, C12	Capacitor, .1 μF	900001-013	Amperex	C280AE	3
C13	Capacitor, 1000 μF	900040-001	General Inst	977-188	1
C14	Capacitor, .005 μF	9000012-004	Erie	801Z5U502Z	1
C15	Capacitor, .1 μF	900001-013	Amperex	C280AE	1
C16	Capacitor, 2 μF	900026-035	SEI Mfg.	17W	1
C17	Capacitor, .1 μF	900001-013	Amperex	C280AE	1
C18	Not Used				0
C19, C20	Capacitor, .1 μF	900001-013	Amperex	C280AE	2
C21, C22	Capacitor, .1 μF	900001-013	Amperex	C280AE	2
C23, C24	Capacitor, 1000 pF	900003-056	Electromotive	DM15	2
C25, C26, C27	Capacitor, .1 μF	900001-013	Amperex	C280AE	3
C28, C30, C34, C35, C36	Capacitor, 120 μF	900115-001	Dickson Elect	D 120GSD15M	5
C29, C33	Capacitor, 0.1 μF	900115-002	Dickson Elect	DR10GSA50M	2
C31, C32	Capacitor, 75 pF	900003-027	Electromotive	DM15	2
CR1	Diode, Zener	913073-001	Power Component	JZ5B	1
CR2, CR3	Not Used				0
CR4-CR6	Diode, 1N4148	913007-001	GE	1N4148	3
Q1-Q6	Transistor, 2N3904	958000-001	Motorola	2N3904-5	6
Q7	Transistor, 2N3906	958000-002	Motorola	2N3906-5	1

DIVIDER AND AUTOMATIC LEVEL CONTROL ASSEMBLY A1A2 (CONT)

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
Q8, Q9	Transistor, 2N3904	958000-001	Motorola	2N3904-5	2
R1	Resistor, Carbon, 680 ohm	945000-035	Allen-Bradley	Type CB	1
R2	Resistor, Carbon, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R3	Resistor, Carbon, 470 ohm	945000-033	Allen-Bradley	Type CB	1
R4	Resistor, Carbon, 10 k	945000-049	Allen-Bradley	Type CB	1
R5	Resistor, Carbon, 3.3 k	945000-043	Allen-Bradley	Type CB	1
R6	Resistor, Carbon, 10 ohm	945000-013	Allen-Bradley	Type CB	1
R7	Resistor, Carbon, 4.7 k	945000-045	Allen-Bradley	Type CB	1
R8	Resistor, Carbon 10%, 1k	945000-037	Allen-Bradley	Type CB	1
R9	Resistor, Carbon, 5%, 39 ohm	945001-128	Allen-Bradley	Type EB	1
R10	Resistor, Carbon, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R11	Resistor, Carbon, 470 ohm	945000-033	Allen-Bradley	Type CB	1
R12	Resistor, Carbon, 180 ohm	945000-028	Allen-Bradley	Type CB	1
R13	Resistor, Carbon, 470 ohm	945000-033	Allen-Bradley	Type CB	1
R14	Resistor, Carbon, 10%, 1 k	945000-037	Allen-Bradley	Type CB	1
R15	Resistor, Carbon, 180 ohm	945000-028	Allen-Bradley	Type CB	1
R16	Resistor, Carbon, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R17	Resistor, Comp, 12%, 1 k	945000-037	Allen-Bradley	Type CB	1
R18	Resistor, Carbon, 180 ohm	945000-028	Allen-Bradley	Type CB	1
R19	Resistor, Carbon, 5%, 150 ohm	945088-114	Corning	NA55D	1
R20	Resistor, Carbon, 12.1 k	945016-297	Allen-Bradley	RN60D	1
R21, R22	Resistor, Carbon, 2.21 k	945016-226	Allen-Bradley	RN60D	2
R23	Resistor, Carbon, 5.11 k	945016-261	Allen-Bradley	RN60D	1
R24	Resistor, Carbon, 1%, 130 k	945016-300	Allen-Bradley	RN60D	1
R25	Not Used				0
R26	Resistor, Carbon, 47 ohm	945000-021	Allen-Bradley	Type CB	1
R27	Resistor, Carbon, 4.32 k	945016-254	Allen-Bradley	RN60D	1
R28, R29	Resistor, Carbon, 4.7 k	945000-045	Allen-Bradley	Type CB	2
R30	Not Used				0
R31	Resistor, Variable, 1 k	945082-002	Chicago Telephone	190PC102A	1
R32	Not Used				0
R33	Resistor, Carbon, 22 ohm	945000-017	Allen-Bradley	Type CB	1

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
R34	Resistor, Carbon, 15 k	945000-051	Allen-Bradley	Type CB	1
R35	Not Used				0
R36	Resistor, Carbon, 22 ohm	945000-017	Allen-Bradley	Type CB	1
R37, R38	Resistor, Carbon, 4.7 k	945000-045	Allen-Bradley	Type CB	2
R39	Resistor, Carbon, 10 ohm	945000-013	Allen-Bradley	Type CB	1
R40	Resistor, Carbon, 1.8 k	945000-040	Allen-Bradley	Type CB	1
R41	Resistor, Carbon, 5.11 k	945016-261	Allen-Bradley	Type CB	1
R42	Resistor, Carbon, 4.32 k	945016-254	Allen-Bradley	Type CB	1
R43	Resistor, Carbon, 12.1 k	945016-297	Allen-Bradley	Type CB	1
R44, R45	Resistor, Comp, 10%, 2.7 k	945000-042	Allen-Bradley	Type CB	2
R46, R48	Resistor, Comp, 10%, 680 ohm	945000-035	Allen-Bradley	Type CB	2
R47	Resistor, Comp, 10%, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R49	Resistor, Selected, 3.3 k nominal	945000-043	Allen-Bradley	Type CB	1
R50	Resistor, Comp, 2.2 k	945000-041	Allen-Bradley	Type CB	1
R51	Resistor, Comp, 100 ohm	945001-138	Allen-Bradley	Type EB	1
R52	Resistor, Comp, 10%, 270 ohm	945000-030	Allen-Bradley	Type CB	1
R53	Resistor, Comp, 10%, 470 ohm	945000-033	Allen-Bradley	Type CB	1
U1, U2	Integrated Ckt	926007-014	Texas Instrument	SN7490	2
U3, U4	Not Used				0
U5, U6	Integrated Ckt	926005-001	RCA	CA3028A	2
U7	Integrated Ckt	926056-001	RCA	CA3029A	1

AF AND IF AMPLIFIER POWER SUPPLY ASSEMBLY A1A3

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
C1, C2	Capacitor, 1500 μF, 25 V	900040-002	Gen. Instr. Corp. Capacitor Grp.	977-206	2
C3	Not Used				0
C4	Capacitor, 50 μF	900039-005	Gen.Inst.Corp	984-1654	1
C5	Capacitor, 25 μF, 25 V	900039-001	Gen. Instr. Corp. Capacitor Grp.	984-2203	1
C6	Capacitor, .01 μF	900001-001	Amperex	C280AE	1
C7	Capacitor, 25 μF, 25 V	900039-001	Gen. Instr. Corp. Capacitor Grp.	984-118	1
C8, C9, C10	Capacitor, 200 μF, 15 V	900039-002	Gen. Instr. Corp. Capacitor Grp.	984-1733	3
C11, C12	Capacator, 25 μF, 25 V	900039-001	Gen. Instr. Corp. Capacitor Grp.	984-118	2
C13	Capacitor, 1200 pF	900003-057	Electromative	DM15	1
C14	Capacitor, 150 pF	900003-034	Electromotive	DM15	1
C15	Capacitor, 250 pF	900003-040	Electromotive	DM15	1
C16	Capacitor, .022 μF	900001-005	Amperex	C280AE	1
C17	Capacitor, 200 μF, 15 V	900039-002	Gen. Instr. Corp. Capacitor Grp.	984-141	1
C18	Capacitor, .001 μF	900012-002	Erie	8612SU102P	1
C19	Capacitor, 100 pF	900003-030	Electromotive	DM15	1
C20	Capacitor, 25μF, 25 V	900039-001	Gen. Instr. Corp. Capacitor Grp.	984-118	1
C21	Capacitor, .047 μF	900001-009	Amperex	C280AE	1
C22	Capacator, 1000 μF, 15 V	900040-001	Gen. Instr. Corp. Capacitor Grp.	977-188	1
C23	Not Used				0
C24	Capacitor, 25 μF, 25 V	900039-001	Gen. Instr. Corp. Capacitor Grp.	984-118	1
CR1	Diode, Zener, 13 V	913004-216	Motorola	MZ1000-16	1
CR2	Diode	913001-002	Motorola	1N4002	1

AF AND IF AMPLIFIER POWER SUPPLY ASSEMBLY A1A3 (CONT)

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
CR3	Not Used				0
CR4	Diode, Zener, 6.2 V	913004-208	Power Comp.	JZ 6.2A	1
CR5	Diode	913007-001	GE	1N4148	1
CR6	Not Used				0
L1	Coil	906006-003	Artted		1
Q1	Transistor	958001-002	Motorola	MJE520	1
Q2	Not Used				0
Q3	Transistor	958001-002	Motorola	MJE 520	1
Q4	Transistor	958000-002	Motorola	2N3906	1
Q5-Q10	Transistor	958000-001	Motorola	2N3904	6
Q11	Transistor	958000-002	Motorola	2N3906	1
R1	Resistor, Carbon, 470 ohm	945000-033	Allen-Bradley	Type CB	1
R2	Not Used				0
R3	Resistor, Carbon, 470 ohm	945001-033	Allen-Bradley	Type EB	1
R4	Not Used				0
R5	Not Used				0
R6	Resistor, Carbon, 1 k	945000-037	Allen-Bradley	Type CB	1
R7	Resistor, Carbon, 4.7 k	945000-045	Allen-Bradley	Type CB	1
R8	Resistor, Carbon, 220 ohm	945000-029	Allen-Bradley	Type CB	1
R9	Resistor, Carbon, 390 ohm	945000-032	Allen-Bradley	Type CB	1
R10	Resistor, Var., 1 k	945010-004	Chicago Tel.	U 201	1
R11	Resistor, Carbon, 1.5 k	945000-039	Allen-Bradley	Type CB	1
R12	Resistor, Carbon, 470 ohm	945000-033	Allen-Bradley	Type CB	1
R13	Resistor, Carbon, 220 ohm	945000-029	Allen-Bradley	Type CB	1
R14	Resistor, Carbon, 470 ohm	945000-033	Allen-Bradley	Type CB	1
R15	Resistor, Carbon, 470 k	945000-069	Allen-Bradley	Type CB	1
R16	Resistor, Carbon, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R17	Not Used				0
R18	Resistor, Carbon, 2.2 k	945000-041	Allen-Bradley	Type CB	1
R19	Resistor, Carbon, 22 k	945000-053	Allen-Bradley	Type CB	1
R20	Resistor, Carbon, 4.7 k	945000-045	Allen-Bradley	Type CB	1

AF AND IF AMPLIFIER POWER SUPPLY ASSEMBLY A1A3 (CONT)

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
R21	Resistor, Carbon, 3.3 k	945000-043	Allen-Bradley	Type CB	1
R22	Resistor, Carbon, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R23	Resistor, Carbon, 3.3 k	945000-043	Allen-Bradley	Type CB	1
R24	Resistor, Carbon, 3.9 k	945000-044	Allen-Bradley	Type CB	1
R25	Resistor, Carbon, 2.2 k	945000-041	Allen-Bradley	Type CB	1
R26	Resistor, Carbon, 10 ohm	945000-013	Allen-Bradley	Type CB	1
R27	Resistor, Carbon, 27 k	945000-054	Allen-Bradley	Type CB	1
R28	Not Used				0
R29	Not Used				0
R30	Resistor, Variable, 500 ohm	945007-003	Chicago Tel.	X201	1

BROADBAND AMPLIFIER AND DETECTOR ASSEMBLY A1A4

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
C1 - C9	Capacitor, .1 μF	900001-013	Amperex	C280AE	9
C10	Capacator, .001 μF	9000012-002	Erie	861Z5U102P	1
C11	Capacitor, .1 μF	900001-113	Amperex	C280AE	1
C12	Capacitor, 150 pF	900003-034	Electromotive	DM15	1
C13	Capacitor, 2 pF	900003-002	Electromotive	DM15	1
C14	Not Used				0
C15	Capacitor, .047 μF	900001-009	Amperex	C280AE	1
CR1, CR2	Diode	913026-003	GE	BD-3	2
L1	Coil, 4T	402869-003	Singer		1
L2, L4	Coil 3T	402869-001	Singer		2
L3	Coil, .22 μH	906008-001	Wilco Corp.		1
L5	Coil, 3T	402869-002	Singer		1
Q1 - Q3	Transistor	958018-001	Motorola	2N5179	3
R1	Resistor, Carbon, 82 ohm	945000-024	Allen-Bradley	Type CB	1
R2	Resistor, Carbon, 390 ohm	945000-032	Allen-Bradley	Type CB	1
R3	Resistor, Carbon, 22 k	945000-053	Allen-Bradley	Type CB	1

BROADBAND AMPLIFIER AND DETECTOR ASSEMBLY A1A4 (CONT)

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
R4	Resistor, Carbon, 4.7 k	945000-045	Allen-Bradley	Type CB	1
R5	Resistor, Carbon, 470 ohm	945000-033	Allen-Bradley	Type CB	1
R6	Resistor, Carbon, 4.7 k	945000-045	Allen-Bradley	Type CB	1
R7	Resistor, Carbon 10 ohm	945000-013	Allen-Bradley	Type CB	1
R8	Resistor, Carbon, 47 ohm	945000-021	Allen-Bradley	Type CB	1
R9	Resistor, Carbon, 22 k	945000-053	Allen-Bradley	Type CB	1
R10, R11	Resistor, Carbon, 470 ohm	945000-033	Allen-Bradley	Type CB	2
R12	Resistor, Carbon, 4.7 k	945000-045	Allen-Bradley	Type CB	1
R13	Resistor, Carbon, 10 ohm	945000-013	Allen-Bradley	Type CB	1
R14	Resistor, Carbon, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R15	Resistor, Carbon, 15 k	945000-051	Allen-Bradley	Type CB	1
R16	Resistor, Carbon, 270 ohm	945000-030	Allen-Bradley	Type CB	1
R17	Resistor, Carbon, 47 ohm	945000-021	Allen-Bradley	Type CB	1
R18	Resistor, Carbon, 470 ohm	945000-033	Allen-Bradley	Type CB	1
R19	Resistor, Carbon, 3.9 k	945000-044	Allen-Bradley	Type CB	1
R20	Resistor, Carbon, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R21	Resistor, Carbon, 150 ohm	945000-027	Allen-Bradley	Type CB	1
R22	Resistor, Carbon, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R23	Resistor, Carbon, 270 ohm	945000-030	Allen-Bradley	Type CB	1
R24	Resistor, Carbon, 4.7 k	945000-045	Allen-Bradley	Type CB	1
R25	Resistor, Carbon, 47 ohm	945000-021	Allen-Bradley	Type CB	1
R26	Resistor, Carbon, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R27	Resistor, Carbon, 68 ohm	945000-023	Allen-Bradley	Type CB	1
R28	Resistor, Carbon, 100 ohm	945000-025	Allen-Bradley	Type CB	1

VCO, 6-, AND 9-MHz GENERATOR ASSEMBLY A2

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
C1	Capacitor, 01 μF	900001-001	Amperex	C280AE	1
C2-C4	Capacitor, .022 μF	900001-005	Amperex	C280AE	3
C5	Capacitor, .1 μF	900001-013	Amperex	C280AE	1
C6	Capacitor, .047 μF	900001-009	Amperex	C280AE	1
C7	Capacitor, 250 pF	900003-040	Electromotive	DM15	1
C8	Capacitor, 22 pF	900003-013	Electromotive	DM15	1
C9-C11	Capacitor, 56 pF	900003-024	Electromotive	DM15	3
C12	Capacitor, 33 pF	900003-017	Electromotive	DM15	1
C13	Capacitor, 270 pF	900003-041	Electromotive	DM15	1
C14-C16	Capacitor, 1000 pF	900003-056	Electromotive	DM15	3
C17	Capacitor, 470 pF	900003-047	Electromotive	DM15	1
C18, C19	Capacitor, .1 μF	900001-013	Amperex	C280AE	2
C20	Capacitor, 200 pF	900003-037	Electromotive	DM15	1
C21	Capacitor, .1 μF	900001-013	Amperex	C280AE	1
C22	Capacitor, .01 μF	900001-001	Amperex	C280AE	1
C23	Capacitor, 10 pF, N750	900067-001	Erie	831-000 U2J0 100D	1
C24, C25	Capacitor, .01 μF	900001-001	Amperex	C280AE	2
C26	Capacitor, 2 μF	900023-016	Sprague	TE-1201	1
C27	Capacitor, 1000 pF	900003-056	Electromotive	DM15	1
C28	Capacitor, .1 μF	900001-013	Amperex	C280AE	1
CR1, CR2	Diode	913029-011	Motorola	MV840	2
CR3	Diode	913007-001	G.E.	1N 4148	1
L1-L4	Coil	906006-005	Artted		4
L5	Coil	906006-004	Artted		1
Q1	Transistor	958000-002	Motorola	2N3906	1
Q2-Q7	Transistor	958000-001	Motorola	2N3904	6
Q8	Transistor	958000-002	Motorola	2N3906	1
Q9	Transistor	958000-001	Motorola	2N3904	1
Q10	Transistor	958046-001	Motorola	MPS 6579	1
R1	Resistor, Carbon, 10%, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R2	Resistor, Carbon, 10%, 470 ohm	945000-033	Allen-Bradley	Type CB	1
R3	Resistor, Carbon, 10%, 100 ohm	945000-025	Allen-Bradley	Type CB	1

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
Q8	Transistor, 2N3906	958000-002		2N3906	1
Q9	Transistor, 2N3904	958000-001		2N3904	1
Q10	Transistor, MPS 6597	958046-001		MPS 6597	1
R1	Resistor, Carbon, 10%, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R2	Resistor, Carbon, 10%, 470 ohm	945000-033	Allen-Bradley	Type CB	1
R3	Resistor, Carbon, 10%, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R4, R5	Resistor, Carbon, 10%, 560 ohm	945000-034	Allen-Bradley	Type CB	2
R6, R7	Resistor Carbon, 10%, 100 ohm	945000-025	Allen-Bradley	Type CB	2
R8	Resistor, Carbon, 10%, 3.3k	945000-043	Allen-Bradley	Type CB	1
R9	Resistor, Carbon, 10%, 1k	945000-037	Allen-Bradley	Type CB	1
R10	Resistor, Carbon, 10%, 150 ohm	945000-027	Allen-Bradley	Type CB	1
R11	Resistor, Carbon, 10%, 270 ohm	945000-030	Allen-Bradley	Type CB	1
R12	Resistor, Carbon, 10%, 270 k	945000-066	Allen-Bradley	Type CB	1
R13	Resistor, Carbon, 10%, 270 ohm	945000-030	Allen-Bradley	Type CB	1
R14	Resistor, Carbon, 10%, 470 ohm	945000-033	Allen-Bradley	Type CB	1
R15	Resistor, Carbon, 10%, 270 k	945000-066	Allen-Bradley	Type CB	1
R16	Resistor, Carbon, 10%, 270 ohm	945000-030	Allen-Bradley	Type CB	1
R17	Resistor, Carbon, 10%, 1 k	945000-037	Allen-Bradley	Type CB	1
R18	Resistor, Carbon, 10%, 47 ohm	945000-021	Allen-Bradley	Type CB	1
R19	Resistor, Carbon, 10%, 10k	945000-049	Allen-Bradley	Type CB	1
R20	Resistor, Carbon, 10%, 2.2k	945000-041	Allen-Bradley	Type CB	1
R21	Resistor, Carbon, 10%, 47 ohm	945000-021	Allen-Bradley	Type CB	1
R22	Resistor Carbon, 10%, 100 k	945000-061	Allen-Bradley	Type CB	1
R23	Resistor, Carbon, 10%, 330 ohm	945000-031	Allen-Bradley	Type CB	1
R24	Not Used				0
R25	Resistor, Carbon, 10%, 15k	945000-051	Allen-Bradley	Type CB	1
R26	Resistor, Carbon, 10%, 180 ohm	945000-028	Allen-Bradley	Type CB	1
R27	Resistor, Carbon, 10%, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R28	Resistor, Carbon, 10%, 10k	945000-049	Allen-Bradley	Type CB	1
R29	Resistor, Carbon, 10%, 4.7 k	945000-045	Allen-Bradley	Type CB	1
R30	Resistor, Var., 2.5 k	945007-005	Chicago Tel. Supply	X201	1
R31	Resistor, Var., 1 k	945007-004	Chicago Tel. Supply	X201	1

VCO, 6-, AND 9-MHz GENERATOR ASSEMBLY A2 (CONT)

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
R32	Resistor, Carbon, 10%, 1k	945000-037	Allen-Bradley	Type CB	1
R33	Resistor, Carbon, 10%, 27k	945000-054	Allen-Bradley	Type CB	1
R34	Resistor, Carbon, 10%, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R35	Resistor, Carbon, 10%, 10 k	945000-049	Allen-Bradley	Type CB	1
R36	Resistor, Carbon, 10%, 1 Meg	945000-073	Allen-Bradley	Type CB	1
R37	Resistor, Carbon, 10%, 6.8 k	945000-047	Allen-Bradley	Type CB	1
R38, R39	Resistor, Carbon, 10%, 47 k	945000-057	Allen-Bradley	Type CB	2
R40	Resistor, Carbon, 10%, 15 k	945000-051	Allen-Bradley	Type CB	1
R41	Resistor, Carbon, 10%, 22 k	945000-053	Allen-Bradley	Type CB	1
R42, R43	Resistor, Carbon, 10%, 1 k	945000-037	Allen-Bradley	Type CB	2
R44	Resistor, Var., 5 k	945007-006	Chicago Tel. Supply	X201	1
R45	Resistor, Carbon, 10%, 470 ohm	945000-033	Allen-Bradley	Type CB	1
R46	Resistor, Carbon, 10%, 3.9 k	945000-044	Allen-Bradley	Type CB	1
R47	Resistor, Var., 100 k	945007-010	Chicago Tel. Supply	X201	1
R48	Resistor, Carbon, 10%, 100 k	945000-061	Allen-Bradley	Type CB	1

1 KHz DECADE, 10 KHz DECADE, AND 100 KHz DECADE ASSEMBLIES A3, A4, AND A5

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
C1	Capacator, 100 pF	900003-030	Electromotive	DM15	1
C2	Capacitor, 150 pF	900003-034	Electromotive	DM15	1
C3	Capacitor, .047 μF	900001-009	Amperex	C280AE	1
C4, C5	Capacitor, .1 μF	900001-003	Amperex	C280AE	2
C6	Capacitor, 10 pF	900003-008	Electromotive	DM15	1
C7, C8, C9, C10	Capacitor, .1 μF	900001-013	Amperex	C280AE	4
C11	Capacitor Selected, 10 pF nominal	900003-008	Electromotive	DM15	1
C12	Capacitor, 180 pF	900003-036	Electromotive	DM15	1
C13	Capacitor, 470 pF	900003-047	Electromotive	DM15	1
C14	Capacitor, 2 pF	900003-002	Electromotive	DM15	1

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
C15	Capacitor, 180 pF	900003-036	Electromotive	DM15	1
C16	Capacitor, 470 pF	90000-047	Electromotive	DM15	1
C17	Capacitor, 100 pF	900003-030	Electromotive	DM15	1
C18	Capacitor, .01 F	900001-001	Amperex	C280AE	1
C19, C20	Capacitor, .1 μF	900001-013	Electromotive	DM15	2
C21	Capacitor, .01 μF	900001-001	Amperex	C280AE	1
C22, C23, C24	Capacitor, .1 μF	900001-013	Amperex	C280AE	3
C25, C26, C27	Capacitor, .01 μF	900001-001	Amperex	C280AE	3
C28	Capacitor .047 μF	900001-009	Amperex	C280AE	1
C29, C31	Capacitor, 1500 pF	900004-015	Electromotive	DM19	2
C30	Capacitor, 2000 pF	900004-018	Electromotive	DM19	1
CR1	Diode	913005-001	Transitron	1N273	1
CR2	Diode, Zener, 5V	913073-001	Power Comp.	JZ5B	1
FL1	Filter - Band Pass, 5-6 MHz	004539-001	Singer		1
L1, L2	RF Coil	906006-006	Artted		2
L3	Choke, RF 10 μH	906022-005	Hytronics	13-10-10	1
L4, L5	Choke, 1.9 μH	906022-006	Hytronics	10-1.9-10	2
L6	Inductor, Molded 220 μH	906003-041	Hytronics	DD-220	1
Q1-Q6	Transistor	958000-001	Motorola	2N3904-5	6
R1	Not Used				0
R2	Resistor, 10%, 68 ohm	945001-023	Allen-Bradley	Type EB	1
R3	Resistor, 10%, 4.7 k	945000-045	Allen-Bradley	Type CB	1
R4	Resistor, 10%, 3.9 ohm	945000-044	Allen-Bradley	Type CB	1
R5	Resistor, 10%, 330 ohm	945000-031	Allen-Bradley	Type CB	1
R6	Resistor, 10%, 390 ohm	945000-032	Allen-Bradley	Type CB	1
R7	Resistor, Variable, 500 ohm	945010-003	Chicago Tel. Supply	U201	1
R8	Resistor, 10%, 4.7 k	945000-045	Allen-Bradley	Type CB	1
R9	Resistor, 10%, 3.9 k	945000-044	Allen-Bradley	Type CB	1
R10	Resistor, 10%, 330 ohm	945000-031	Allen-Bradley	Type CB	1
R11	Resistor, 10%, 10 ohm	945000-013	Allen-Bradley	Type CB	1
R12	Resistor, 10%, 4.7 k	945000-045	Allen-Bradley	Type CB	1
R13	Resistor, 10%, 1k	945000-037	Allen-Bradley	Type CB	1

1 KHz DECADE, 10 KHz DECADE, AND 100 KHz DECADE ASSEMBLIES A3, A4, AND A5 (CONT)

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
R14	Resistor, 10%, 470 ohm	945000-033	Allen-Bradley	Type CB	1
R15	Resistor, 10%, 10 ohm	945000-013	Allen-Bradley	Type CB	1
R16	Resistor, 10%, 1.8 K	945000-040	Allen-Bradley	Type CB	1
R17	Resistor, 5%, 62 ohm	945000-113	Allen-Bradley	Type CB	1
R18	Resistor, 10%, 150 k	945000-063	Allen-Bradley	Type CB	1
R19	Resistor, 10%, 10 ohm	945000-013	Allen-Bradley	Type CB	1
R20	Resistor, 10%, 150 ohm	945000-027	Allen-Bradley	Type CB	1
R21	Resistor, 10%, 1 k	945000-037	Allen-Bradley	Type CB	1
R22, R23	Resistor, 10%, 47 ohm	945000-021	Allen-Bradley	Type CB	2
U1	Integrated Circuit	926007-014	Texas Inst.	SN7490 N	1
U2, U3	Integrated Circuit	926007-026	Texas Inst.	SN76514 N	2

1 MHz DECADE ASSEMBLY A6

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
C1	Capacitor, .01 μF	90000-001	Amperex	C280AE	1
C2	Capacitor, 1000 pF	900003-056	Electromotive	DM15	1
C3	Capacitor, .01 μF	900001-001	Amperex	C280AE	1
C4, C5	Capacitor, .1 μF	900001-013	Amperex	C280AE	2
C6	Capacitor, 1000 pF	900003-056	Electromotive	DM15	1
C7, C8	Capacitor, .1 μF	900001-013	Amperex	C280AE	2
C9-C12	Capacitor, 1000 pF	900003-056	Electromotive	DM15	4
C13	Capacitor, 68 pF	900003-026	Electromotive	DM15	1
C14	Capacitor, 12 pF	900003-009	Electromotive	DM15	1
C15	Capacitor, 1000 pF	900003-056	Electromotive	DM15	1
C16	Capacitor, .01 μF	900001-001	Amperex	C280AE	1
C17, C20	Capacitor 1000 pF	900003-056	Electromotive	DM15	4
C21	Capacitor, 470 pF	900003-047	Electromotive	DM15	1
C22-C25	Capacitor, 1000 pF	900003-056	Electromotive	DM15	4
C26	Capacitor, .01 μF	900001-001	Amperex	C280AE	1
C27	Capacitor, 1000 pF	900003-056	Electromotive	DM15	1

1 MHz DECADE ASSEMBLY A6 (CONT)

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
C28	Capacitor, 300 pF	900003-042	Electromotive	DM15	1
C29	Capacitor, .01 μF	900001-001	Amperex	C280AE	1
C30	Capacitor, 470 pF	900003-047	Electromotive	DM15	1
C31	Capacitor, 1000 pF	900003-056	Electromotive	DM15	1
C32	Capacitor, .1 μF	900001-013	Amperex	C280AE	1
C33	Capacitor, 130 pF	900003-033	Electromotive	DM15	1
C34	Capacitor, 270 pF	900003-041	Electromotive	DM15	1
C35	Capacitor, 200 pF	900003-037	Electromotive	DM15	1
FL1	Filter, 95-96 MHz	004540-001	Singer		1
FL2	Filter, 50-60 MHz	004538-001	Singer		1
L1	Coil, .16- .23 μH	906006-008	Artted		1
L2, L4	Coil, .47 μH	906022-008	Nytronics	9-0.47-1	2
L3	Coil, 1.5 μH	906022-007	Nytronics	10-1.5-10	1
L5, L6	Coil, .15 μH	906003-003	Nytronics	00-0.15	2
Q1-Q4	Transistor	958018-001	Motorola	2N5179	4
Q5	Transistor	958080-001	Motorola	2N4427	1
R1	Resistor, Carbon, 5%, 330 ohm	945000-150	Allen-Bradley	Type CB	1
R2	Not Used				0
R3	Resistor, Carbon, 5%, 56 ohm	945000-132	Allen-Bradley	Type CB	1
R4	Resistor, Carbon, 5%, 150 ohm	945000-142	Allen-Bradley	Type CB	1
R5	Not Used				0
R6	Resistor, Carbon, 5%, 68 ohm	945000-134	Allen-Bradley	Type CB	1
R7	Resistor, Carbon, 10%, 10 ohm	945000-013	Allen-Bradley	Type CB	1
R8	Resistor, Carbon, 10%, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R9	Resistor, Carbon, 10%, 7.5 k	945000-183	Allen-Bradley	Type CB	1
R10	Resistor, Carbon, 10%, 3.9 k	945000-044	Allen-Bradley	Type CB	1
R11	Not Used				0
R12	Resistor, Carbon, 10%, 330 ohm	945000-031	Allen-Bradley	Type CB	1
R13	Not Used				0
R14	Resistor, Carbon, 10%, 10 k	945000-049	Allen-Bradley	Type CB	1
R15	Resistor, Carbon, 10%, 3.9 k	945000-044	Allen-Bradley	Type CB	1
R16	Resistor, Selected, 33 ohm nominal	945000-013	Allen-Bradley	Type CB	1
R17, R18	Resistor, Carbon, 10%, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R19	Resistor, Carbon, 10%, 47 ohm	945000-021	Allen-Bradley	Type CB	1

1 MHz DECADE ASSEMBLY A6 (CONT)

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
R20	Resistor, Carbon, 10%, 10 ohm	945000-013	Allen-Bradley	Type CB	1
R21	Resistor, Carbon, 5%, 2k	945000-169	Allen-Bradley	Type CB	1
R22	Resistor, Carbon, 10%, 10k	945000-049	Allen-Bradley	Type CB	1
R23	Resistor, Carbon, 10%, 270 ohm	945000-030	Allen-Bradley	Type CB	1
R24	Resistor, Carbon, 10%, 6.8k	945000-047	Allen-Bradley	Type CB	1
R25	Resistor, Carbon, 10%, 1k	945000-037	Allen-Bradley	Type CB	1
R26	Resistor, Carbon, 10%, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R27	Resistor, Carbon, 5%, 2.4k	945000-171	Allen-Bradley	Type CB	1
R28	Resistor, Carbon, 10%, 820 ohm	945000-036	Allen-Bradley	Type CB	1
R29	Resistor, Selected 270 ohm nominal	945000-030	Allen-Bradley	Type CB	1
R30	Resistor, Carbon, 10%, 10	945000-013	Allen-Bradley	Type CB	1
R31	Resistor, Selected, 10 ohm nominal	945000-013	Allen-Bradley	Type CB	1
R32	Resistor, Carbon, 5%, 150 ohm	945000-142	Allen-Bradley	Type CB	1
R33	Resistor, Carbon, 5%, 39 ohm	945000-128	Allen-Bradley	Type CB	1
R34	Resistor, Carbon, 10%, 150 ohm	945000-142	Allen-Bradley	Type CB	1
R35	Resistor, Carbon, 5%, 300 ohm	945000-149	Allen-Bradley	Type CB	1
R36	Resistor, Carbon, 5%, 16 ohm	945000-119	Allen-Bradley	Type CB	1
R37	Resistor, Carbon, 5%, 300 ohm	945000-149	Allen-Bradley	Type CB	1
U1, U2	Integrated circuit	926007-026	Texas Instr.	SN76514N	2

GAIN CONTROL AMPLIFIER ASSEMBLY A7

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
C1-C23	Not Used				0
C24	Capacitor, 47 pF	90003-021	Electromotive	DM15	1
C25, C26	Capacitor, Trim, 1-10 pF	900063-001	Johanson Mfg	7341-A	2
C27	Capacitor Standoff, 470 pF	900044-001	Allen-Bradley	SS5D-471W	1
C28	Capacitor, Trim, 1-10 pF	900063-001	Johanson Mfg	7341-A	1
C29	Capacitor, 47 pF	90003-021	Electromotive	DM15	1
C30	Capacitor, Standoff, 470 pF	900044-001	Allen-Bradley	SS5D-471W	1
C31	Capacitor, Trim, 1-10 pF	900063-001	Johanson Mfg	7341-A	2
C32	Capacitor, 47 pF	90003-021	Electromotive	DM15	1

GAIN CONTROL AMPLIFIER ASSEMBLY A7 (CONT)

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
C33	Capacitor, Feed Thru, 470 pF	900045-001	Allen-Bradley	FASC-4712	1
C34, C35	Not Used				0
C36	Capacitor, Standoff, 470 pF	900044-001	Allen-Bradley	SS5D-471W	1
C37, C38	Capacitor, Standoff, 470 pF	900044-001	Allen-Bradley	SS5D-471W	2
C39	Capacitor, Standoff, 470 pF	900044-001	Allen-Bradley	SS5D-471W	1
C40	Capacitor, 2 pF	900003-002	Electromotive	DM15	1
C41	Capacitor 470 pF	900003-047	Electromotive	DM15	1
C42	Capacitor, 2 pF	900003-002	Electromotive	DM15	1
CR1, CR2	Diode	913005-001	Transitron	1N273	2
L1-L8	Not Used				0
L9	Coil 2T	402953-001	Singer	–	1
L10	Coil 4T	402953-003	Singer	–	1
L11	Coil 3T	402953-002	Singer	–	1
L12	Coil 4T	402953-003	Singer	–	1
L13	Coil 3T	402953-002	Singer	–	1
L14	Coil RF .47 μH	906008-002	Wilco Corp.		1
Q1-Q7	Not Used				0
Q8	Transistor	958018-001	Motorola	2N5179	1
Q9	Transistor	958018-001	Motorola	2N5179	1
R1-R14	Not Used				0
R15	Resistor, 10%, 47 ohm	945000-021	Allen-Bradley	CB	1
R16	Resistor, 10%, 39 k	945000-056	Allen-Bradley	CB	1
R17	Resistor, 10%, 820 ohm	945000-036	Allen-Bradley	CB	1
R18	Resistor, 10%, 33 k	945000-055	Allen-Bradley	CB	1
R19	Resistor, 10%, 470 ohm	945000-033	Allen-Bradley	CB	1
R20	Resistor, 10%, 2.7 ohm	945000-006	Allen-Bradley	CB	1
R21	Resistor, 10%, 33 k	945000-053	Allen-Bradley	CB	1
R22	Resistor, 10%, 100 ohm	945000-025	Allen-Bradley	CB	1
R23, R24	Resistor, 10%, 8.2 k	945000-048	Allen-Bradley	CB	2

10 MHz DECADE ASSEMBLY A8

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
C1	Capacitor, 22 pF	900003-013	Electromotive	DM15	1
C2	Capacitor, Standoff, 470 pF	900044-001	Allen-Bradley	SS5D-471W	1
C3	Capacitor, Variable, 1-10 pF	900063-001	Johanson Mfg	7341-A	1
C4	Capacitor, 10 pF	900003-008	Electromotive	DM15	1
C5	Capacitor, Standoff, 470 pF	900044-001	Allen-Bradley	SS5D-471W	1
C6	Capacitor, Variable, 1-10 pF	900063-001	Johanson Mfg	7341-A	1
C7	Capacitor, 10 pF	900003-008	Electromotive	DM15	1
C8	Capacitor, Standoff, 470 pF	900044-001	Allen-Bradley	SS5D-471W	1
C9	Capacitor, Variable, 1-10 pF	900063-001	Johanson Mfg	7341-A	1
C10	Capacitor, 3 pF	900003-003	Electromotive	DM15	1
C11	Capacitor, Standoff, 470 pF	900044-001	Allen-Bradley	SS5D-471W	1
C12	Capacitor, Variable, 1-10 pF	900063-001	Johanson Mfg	7341-A	1
C13	Capacitor, 3 pF	900003-003	Electromotive	DM15	1
C14	Not Used				0
C15	Not Used				0
C16	Not Used				0
C17	Capacitor, 10 pF	900003-008	Electromotive	DM15	1
C18	Capacitor, Variable, 1-10 pF	900063-001	Johanson Mfg	7341-A	1
C19	Capacitor, Standoff, 470 pF	900044-001	Allen-Bradley	SS5D-471W	1
C20	Capacitor, 10 pF	900003-008	Electromotive	DM-15	1
C21	Capacitor, Variable, 1-10 pF	900063-001	Johanson Mfg	7341-A	1
C22	Capacitor, Standoff, 470 pF	900044-001	Allen-Bradley	SS5D-471W	1
C23, C24	Capacitor, 10 pF	900003-008	Electromotive	DM15	2
C25	Capacitor, 5 pF	900003-004	Electromotive	DM15	1
C26	Not Used				0
C27	Capacitor, 120 pF	900003-032	Electromotive	DM15	1
C28	Capacitor, Variable 2-20 pF	900113-001	Johanson Mfg	9302	1

10 MHz DECADE ASSEMBLY A8 (CONT)

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
C29	Capacitor, 5 pF	900003-004	Electromotive	DM15	1
C30	Capacitor Trim, 2-20 pF	900013-001	E.F.Johnson		1
C31	Capacitor, 120 pF	900003-032	Electromotive	DM15	1
C32	Capacitor, Selected, 20 pF nominal	900003-002	Electromotive	DM15	1
C33, C34, C35	Capacitor, 3 pF	900003-003	Electromotive	DM15	3
CR1, CR2	Diode	913005-001	Transitron	1N273	2
L1	Inductor	201740-001	Singer		1
L2	Not Used				0
L3, L4, L6, L7	Inductor	201741-001	Singer		4
L5	Not Used				0
L8	Coil 2T	402953-001	Singer		1
L9-L14	Not Used				0
L15, L16	Coil 2T, 300 1D	403042-001	Singer		2
Q1-Q4	Transistor	958018-001	Motorola	2N5179	4
Q5	Not Used				0
Q6, Q7	Transistor	958018-001	Motorola	2N5179	2
R1	Resistor, 10%, 47 k	945000-057	Allen-Bradley	Type CB	1
R2	Resistor, 10%, 330 ohm	945000-031	Allen-Bradley	Type CB	1
R3	Resistor, 10%, 47 k	945000-057	Allen-Bradley	Type CB	1
R4	Resistor, 10%, 330 ohm	945000-031	Allen-Bradley	Type CB	1
R5	Resistor, 10%, 47 k	945000-057	Allen-Bradley	Type CB	1
R6	Resistor, 10%, 330 ohm	945000-031	Allen-Bradley	Type CB	1
R7	Resistor, 10%, 47 k	945000-057	Allen-Bradley	Type CB	1
R8	Resistor, 10%, 330 ohm	945000-031	Allen-Bradley	Type CB	1
R9	Not Used				0
R10	Not Used				0
R11, R13	Resistor, 10%, 560 ohm	945000-034	Allen-Bradley	Type CB	2
R12, R14	Resistor, 10%, 47 k	945000-057	Allen-Bradley	Type CB	2
R15	Resistor, 10%, 27 ohm	945000-018	Allen-Bradley	Type CB	1
Z1	Mixer, Singly balanced	403263-001	Vari-L	SM-161	1

DIODE SWITCH, MIXER, LOW PASS FILTER ASSEMBLY A9

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
C1 - C5	Capacitor, 470 pF	900045-001	Allen-Bradley	FA5C-4712	5
C6	Capacitor, 5 pF	900003-004	Electromotive	DM-15	1
CR1 - CR5	Diode	913005-001	Transistron	1N273	5
L1 - L6	Choke, 0.47 μH	906008-002	Wilco Corp		6
R1 - R5	Resistor, 22k	945000-053	Allen-Bradley	CB	5
R6	Resistor, 270 ohm	945000-050	Allen-Bradley	CB	1

100 MHz DECADE ASSEMBLY A10

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
C1	Capacitor, 22 pF	900003-013	Electromotive	DM15	1
C2	Capacitor, 1-10 pF	900063-001	Johanson	7341-A	1
C3	Capacitor, 470 pF	900044-001	Allen-Bradley	SS5D-471W	1
C4	Capacitor, 10 pF	900003-008	Electromotive	DM15	1
C5	Capacitor, 1-10 pF	9000063-001	Johanson	7341-A	1
C6	Capacitor, 470 pF	900044-001	Allen-Bradley	SS5D-471W	1
C7	Capacitor, 10 pF	900003-008	Electromotive	DM15	1
C8	Capacitor, 1-10 pF	900063-001	Johanson	7341-A	1
C9	Capacitor, 470 pF	900003-047	Electromotive	DM15	1
C10	Capacitor, 3 pF	900003-003	Electromotive	DM15	1
C11	Capacitor, 1-10 pF	900063-001	Johanson	7341-A	1
C12	Capacitor, 470 pF	900044-001	Allen-Bradley	SS5D-471W	1
C13	Capacitor, 5 pF	900003-004	Electromotive	DM15	1
C14	Capacitor, 22 pF	900003-013	Electromotive	DM15	1
C15	Capacitor, 1-10 pF	900063-001	Johanson	7341-A	1
C16	Capacitor, 470 pF	900044-001	Allen-Bradley	SS5D-471W	1
C17	Capacitor, 10 pF	900003-008	Electromotive	DM15	1
C18	Capacitor, 1-10 pF	900063-001	Johanson	7341-W	1
C19	Capacitor, 470 pF	900044-001	Allen-Bradley	SS5D-471W	1
C20	Capacitor, 10 pF	900003-003	Electromotive	DM15	1
C21	Capacitor, 5 pF	900003-004	Electromotive	DM15	1

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
C22	Capacitor, 1-10 pF	900063-001	Johanson	7341-A	1
C23	Capacitor, 470 pF	9000-001	Allen-bradley	SS5D-471W	1
C24	Capacitor, 3 pF	900003-003	Electromotive	DM15	1
C25	Capacitor, 1-10 pF	900063-001	Johanson	7341-A	1
C26	Capacitor, 470 pF	900044-001	Allen-Bradley	SS5D-471W	1
C27	Capacitor, 5 pF	900003-004	Electromotive	DM-15	1
C28	Capacitor, 22 pF	900003-013	Electromotive	DM-15	1
C29	Capacitor, 1-10 pF	900063-001	Johanson	7341-A	1
C30	Capacitor, 470 pF	90004-001	Allen-Bradley	SS5D-471W	1
C31	Capacitor, 10 pF	900003-008	Electromotive	DM-15	1
C32	Capacitor, 1-10 pF	900063-001	Johanson	7341-A	1
C33	Capacitor, 470 pF	900044-001	Allen-Bradley	SS5D-471W	1
C34	Capacitor, 10 pF	900003-008	Electromotive	DM-15	1
C35	Capacitor, Selected, 2 pF nominal	900003-002	Electromotive	DM-15	1
C36	Capacitor, 1-10 pF	900063-001	Johanson	7341-A	1
C37	Capacitor, 470 pF	900044-001	Allen-Bradley	SS5D-471W	1
C38	Capacitor, 3 pF	900003-003	Electromotive	DM-15	1
C39	Capacitor, 1-10 pF	900063-001	Johanson	7341-A	1
C40	Capacitor, 470 pF	900003-047	Electromotive	DM-15	1
C41	Capacitor, 5 pF	900003-004	Electromotive	DM-15	1
C42	Capacitor, 22 pF	900003-013	Electromotive	DM-15	1
C43	Capacitor, 1-10 pF	900063-001	Johanson	7341-A	1
C44	Capacitor, 470 pF	900044-001	Allen-Bradley	SS5D-471W	1
C45	Capacitor, 10 pF	900003-008	Electromotive	DM-15	1
C46	Capacitor, 1-10 pF	900063-001	Johanson	7341-A	1
C47	Capacitor, 470 pF	900044-001	Allen-Bradley	SS5D-471-W	1
C48	Capacitor, 10 pF	900003-008	Electromotive	DM-15	1
C49	Capacitor, 2 pF Selected	900003-002	Electromotive	DM-15	1
C50	Capacitor, 1-10 pF	900063-001	Johanson	7341-A	1
C51	Capacitor, 470 pF	900044-001	Allen-Bradley	SS5D-471W	1
C52	Capacitor, 3 pF	900003-003	Electromotive	DM-15	1
C53	Capacitor, 1-10 pF	900063-001	Johanson	7341-A	1
C54	Capacitor, 470 pF	900044-001	Allen-Bradley	SS5D-471W	1

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
C55	Capacitor, 5 pF	900003-004	Electromotive	DM15	1
C56	Capacator, 22 pF	900003-013	Electromotive	DM-15	1
C57	Capacitor, 1-10 pF	900063-001	Johanson	7341-A	1
C58	Capacitor, 470 pF	900044-001	Allen-Bradley	SS5D-471W	1
C59	Capacitor, 10 pF	900003-008	Electromotive	DM-15	1
C60	Capacitor, 1-10 pF	900063-001	Johanson	7341-A	1
C61	Capacitor, 470 pF	900044-001	Allen-Bradley	SS5D-471W	1
C62	Capacitor, 10 pF	900003-008	Electromotive	DM-15	1
C63	Capacitor, 2 pF Selected	900003-002	Electromotive	DM-15	1
C64	Capacitor, 1-10 pF	900063-001	Johanson	7341-A	1
C65	Capacitor, 470 pF	900044-001	Allen-Bradley	SS5D-471W	1
C66	Capacitor, 3 pF	900003-003	Electromotive	DM15	1
C67	Capacitor, 1-10 pF	900063-001	Johanson	7341-A	1
C68	Capacitor, 470 pF	900044-001	Allen-Bradley	SS5D-471W	1
C69-C72	Capacitor, 5 pF	900003-004	Electromotive	DM15	4
C73-C74	Capacitor, 2 pF Selected	900003-002	Electromotive	DM15	2
C75	Capacitor, 9 pF Selected	900087-001	Electromotive	DM15	1
C76-C78	Capacitor, 2 pF Selected	900003-002	Electromotive	DM15	3
C79, C80	Capacitor 1 pF Selected	900003-001	Electromotive	DM15	2
CR1-CR10	Diode	913005-001	Transitron	1N273	10
L1, L2	Inductor	201740-001	Singer		2
L3, L4	Inductor	201741-001	Singer		2
L5, L6	Inductor	201740-001	Singer		2
L7, L8	Inductor	201741-001	Singer		2
L9, L10	Inductor	201738-001	Singer		2
L11, L12	Inductor	201739-001	Singer		2
L13, L14	Inductor	201738-001	Singer		2
L15, L16	Inductor	201739-001	Singer		2
L17, L18	Inductor	201738-001	Singer		2
L19, L20	Inductor	201739-001	Singer		2
Q1-Q20	Transistor	958018-001	Motorola	2N5179	20
R1	Resistor, 10%, 47 k	945000-057	Allen-Bradley	CB	1
R2	Resistor, 10%, 560 ohm	945000-034	Allen-Bradley	CB	1

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
R3	Resistor, 10%, 47 k	945000-057	Allen-Bradley	CB	1
R4	Resistor, 10%, 560 ohm	945000-041	Allen-Bradley	CB	1
R5	Resistor, 10%, 47 k	945000-057	Allen-Bradley	CB	1
R6	Resistor, 10%, 330 ohm	945000-031	Allen-Bradley	CB	1
R7	Resistor, 10%, 47 k	945000-057	Allen-Bradley	CB	1
R8	Resistor, 10%, 330 ohm	945000-031	Allen-Bradley	CB	1
R9	Resistor, 10%, 47 k	945000-057	Allen-Bradley	CB	1
R10	Resistor, 10%, 560 ohm	945000-034	Allen-Bradley	CB	1
R11	Resistor, 10%, 47 k	945000-057	Allen-Bradley	CB	1
R12	Resistor, 10%, 560 ohm	945000-034	Allen-Bradley	CB	1
R13	Resistor, 10%, 47 k	945000-057	Allen-Bradley	CB	1
R14	Resistor, 10%, 330 ohm	945000-031	Allen-Bradley	CB	1
R15	Resistor, 10%, 47 k	945000-057	Allen-Bradley	CB	1
R16	Resistor, 10%, 330 ohm	945000-031	Allen-Bradley	CB	1
R17	Resistor, 10%, 47 k	945000-057	Allen-Bradley	CB	1
R18	Resistor, 10%, 560 ohm	945000-034	Allen-Bradley	CB	1
R19	Resistor, 10%, 47 k	945000-057	Allen-Bradley	CB	1
R20	Resistor, 10%, 560 ohm	945000-034	Allen-Bradley	CB	1
R21	Resistor, 10%, 47 k	945000-057	Allen-Bradley	CB	1
R22	Resistor, 10%, 330 ohm	945000-031	Allen-Bradley	CB	1
R23	Resistor, 10%, 47 k	945000-057	Allen-Bradley	CB	1
R24	Resistor, 10%, 330	945000-031	Allen-Bradley	CB	1
R25	Resistor, 10% 47 k	945000-057	Allen-Bradley	CB	1
R26	Resistor, 10%, 560 ohm	945000-034	Allen-Bradley	CB	1
R27	Resistor, 10%, 47 k	945000-057	Allen-Bradley	CB	1
R28	Resistor, 10%, 560 ohm	945000-034	Allen-Bradley	CB	1
R29	Resistor, 10%, 47 k	945000-057	Allen-Bradley	CB	1
R30	Resistor, 10%, 330 ohm	945000-031	Allen-Bradley	CB	1
R31	Resistor, 10%, 47 k	945000-057	Allen-Bradley	CB	1
R32	Resistor, 10%, 330 ohm	945000-031	Allen-Bradley	CB	1
R33	Resistor, 10%, 47 k	945000-057	Allen-Bradley	CB	1
R34	Resistor, 10%, 560 ohm	945000-034	Allen-Bradley	CB	1
R35	Resistor, 10%, 47 k	945000-057	Allen-Bradley	CB	1

100 MHz DECADE ASSEMBLY A10 (CONT)

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
R36	Ressistor, 10%, 560 ohm	945000-034	Allen-Bradley	CB	1
R37	Resistor, 10%, 47 k	945000-057	Allen-Bradley	CB	1
R38	Resistor, 10%, 330 ohm	945000-031	Allen-Bradley	CB	1
R39	Resistor, 10%, 47 k	945000-057	Allen-Bradley	CB	1
R40	Resistor, 10%, 330 ohm	945000-031	Allen-Bradley	CB	1
R41-R45	Resistor, 10%, 27 ohm	945000-018	Allen-Bradley	CB	5

TCXO BUFFER AMPLIFIER ASSEMBLY A11

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
A1	TCXO 10 MHZ	402838-003	Motorola		1
C1	Capacitor, 470 pF	900003-047	Electromotive	DM15	1
C2	Capacitor, .01 µF	900001-001	Amperex	C280AE	1
C3	Capacitor, 1000 pF	900003-056	Electromotive	DM15	1
C4	Capacitor, 43 pF	900003-020	Electromotive	DM15	1
C5	Capacitor, Var, 1.7-11 pF	900113-002	JFD	DVJ-302A	1
C6	Capacitor, .022 µF	900001-005	Amperex	C280AE	1
C7	Capacitor, .1 µF	900001-013	Amperex	C280AE	1
C8	Not Used				0
C9, C10	Capacitor, 470 pF	900003-047	Electromotive	DM15	2
C11	Capacitor, 1000 pF	900003-056	Electromotive	DM15	1
C12	Capacitor, 43 pF	900003-020	Electromotive	DM15	1
C13	Capacitor, Var, 1.7-11 pF	900113-002	JFD	DVJ-302A	1
C14	Capacitor, .01 µF	900001-001	Amperex	C280AE	1
C15, C16	Capacitor, 470 pF	900003-047	Electromotive	DM15	2
C17, C18	Capacitor, .01 µF	900001-001	Amperex	C280AE	2
C19	Capacitor, 1000 pF	900003-056	Electromotive	DM15	1
C20	Capacitor, 27 pF	900003-015	Electromotive	DM15	1
C21	Capacitor, Var, 1.7-11 pF	900113-002	JFD	DVJ-302A	1
C22	Capacitor, 470 pF	900003-047	Electromotive	DM15	1

TCXO BUFFER AMPLIFIER ASSEMBLY A11 (CONT)

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
C23	Capacitor, 18 pF	900003-011	Electromotive	DM15	1
C24	Capacitor, 470 pF	900003-047	Electromotive	DM15	1
C25	Capacitor, .01 μF	900001-001	Amperex	C280AE	1
C26	Capacitor, 1000 pF	900003-056	Electromotive	DM15	1
C27	Capacitor, 15 pF	900003-010	Electromotive	DM15	1
C28	Capacitor, Var, 1.7-11 pF	900113-002	JFD	DVJ-302A	1
C29, C30	Capacitor, 470 pF	900003-047	Electromotive	DM15	2
C31	Capacitor, .01 μF	900001-001	Amperex	C280AE	1
C32	Capacitor, 1000 pF	900003-056	Electromotive	DM15	1
C33	Capacitor, 15 pF	900003-010	Electromotive	DM15	1
C34	Capacitor, Var, 1.7-11 pF	900113-002	JFD	DVJ-302A	1
C35, C36	Capacitor, 470 pF	900003-047	Electromotive	DM15	2
C37	Capacitor, .01 μF	900001-001	Amperex	C280AE	1
C38	Capacitor, 1000 pF	900003-056	Electromotive	DM15	1
C39	Capacitor, 15 pF	900003-010	Electromotive	DM15	1
C40	Capacitor, Var, 1.7-11 pF	900113-002	JFD	DVJ-302A	1
C41-C44	Capacitor, 470 pF	900003-047	Electromotive	DM15	4
C45, C46	Capacitor, 1000 pF	900003-056	Electromotive	DM15	2
C47	Capacitor, .01 μF	900001-001	Amperex	C280AE	1
L1	Coil, 1/4" ID, 4.5T	402965-002	Singer		1
L2	Choke, 10 μH	906022-005	Hytronics	13-10-10	1
L3, L4	Coil, 1/4" ID, 4.5T	402965-002	Singer		2
L5	Coil, LR24	906006-004	Artted		1
L6, L7	Coil, 1/4" ID, 4.5T	402965-002	Singer		2
L8	Coil, 1/4" ID, 3.5T	402965-003	Singer		1
Q1-Q8	Transistor	958018-001	Motorola	2N5179	8
R1	Resistor, Carbon, 10 ohm	945000-013	Allen-Bradley	Type CB	1
R2	Resistor, Carbon, 3.9 k	945000-044	Allen-Bradley	Type CB	1
R3, R4	Resistor, Carbon, 100 ohm	945000-025	Allen-Bradley	Type CB	2
R5	Resistor, Carbon, 10 ohm	945000-013	Allen-Bradley	Type CB	1

TCXO BUFFER AMPLIFIER ASSEMBLY A11 (CONT)

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
R6	Resistor, Carbon, 3.9 k	945000-044	Allen-Bradley	Type CB	1
R7	Transistor, Carbon, 2.2 k	945000-041	Allen-Bradley	Type CB	1
R8	Resistor, Carbon, 10 k	945000-049	Allen-Bradley	Type CB	1
R9	Resistor, Carbon, 3.3 k	945000-043	Allen-Bradley	Type CB	1
R10, R11	Resistor, Carbon, 100 ohm	945000-025	Allen-Bradley	Type CB	2
R12	Resistor, Carbon, 470 ohm	945000-033	Allen-Bradley	Type CB	1
R13	Resistor, Carbon, 47 ohm	945000-021	Allen-Bradley	Type CB	1
R14	Resistor, Carbon, 3.9 k	945000-044	Allen-Bradley	Type CB	1
R15	Resistor, Carbon, 1.2 k	945000-038	Allen-Bradley	Type CB	1
R16	Resistor, Carbon, 3.9 k	945000-044	Allen-Bradley	Type CB	1
R17	Resistor, Carbon, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R18	Resistor, Carbon, 22 ohm	945000-017	Allen-Bradley	Type CB	1
R19, R20	Resistor, Carbon, 100 ohm	945000-025	Allen-Bradley	Type CB	2
R21	Resistor, Carbon, 3.9 k	945000-044	Allen-Bradley	Type CB	1
R22	Resistor, Carbon, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R23	Resistor, Carbon, 39 ohm	945000-020	Allen-Bradley	Type CB	1
R24	Resistor, Carbon, 15 ohm	945000-015	Allen-Bradley	Type CB	1
R25	Resistor, Carbon 3.9 k	945000-044	Allen-Bradley	Type CB	1
R26	Resistor, Carbon, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R27	Resistor, Carbon, 22 ohm	945000-017	Allen-Bradley	Type CB	1
R28	Resistor, Carbon, 3.9 k	945000-044	Allen-Bradley	Type CB	1
R29	Resistor, Carbon, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R30	Resistor, Carbon, 22 ohm	945000-017	Allen-Bradley	Type CB	1
R31, R32	Resistor, Carbon, 1.2 k	945000-038	Allen-Bradley	Type CB	2
R33, R36	Resistor, Carbon, 560 ohm	945000-034	Allen-Bradley	Type CB	4
R37	Resistor, Carbon, 100 ohm	945000-025	Allen-Bradley	Type CB	1

FREQUENCY GENERATOR ASSEMBLY A12

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
C1	Capacitor, .1 μF	900001-013	Amperex	C280AE	1
C2, C3	Capacitor, 22 pF	900003-013	Electromotive	DM15	2
C4	Capacitor, 10 pF	900003-008	Electromotive	DM15	1
C5	Capacitor, Variable, 1.7-11 pF	900113-002	JFD	DVJ-302A	1
C6	Capacitor, .01 μF	900001-001	Amperex	C280AE	1
C7	Capacitor, 470 pF	900003-047	Electromotive	DM15	1
C8	Capacitor, .1 μF	900001-013	Amperex	C280AE	1
C9	Capacitor, 43 pF	900003-020	Electromotive	DM15	1
C10	Capacitor, 1000 pF	900003-056	Electromotive	DM15	1
C11	Capacitor, 24 pF	900003-014	Electromotive	DM15	1
C12	Capacitor, 12 pF	900003-009	Electromotive	DM15	1
C13	Capacitor, .022 μF	900001-005	Amperex	C280AE	1
C14	Capacitor, 10 pF	900003-008	Electromotive	DM15	1
C15	Capacitor, .1 μF	900001-013	Amperex	C280AE	1
C16	Capacitor, 2 pF	900003-002	Electromotive	DM15	1
C17	Capacitor, .01 μF	900001-001	Amperex	C280AE	1
C18	Capacitor, 82 pF	900003-028	Electromotive	DM15	1
C19	Capacitor, 470 pF	900003-047	Electromotive	DM15	1
C20	Capacitor, 1000 pF	900003-056	Electromotive	DM15	1
C21	Capacitor, 10 pF	900003-008	Electromotive	DM15	1
C22	Capacitor, 1000 pF	900003-056	Electromotive	DM15	1
C23	Capacitor, 470 pF	900003-047	Electromotive	DM15	1
C24	Capacitor, Variable, 1.7-11 pF	900113-002	JFD	DVJ-302A	1
C25	Capacitor, 82 pF	900003-028	Electromotive	DM15	1
C26	Capacitor, 470 pF	900003-047	Electromotive	DM15	1
C27	Capacitor, .1 μF	900001-013	Amperex	C280AE	1
C28	Capacitor, 15 pF	900003-010	Electromotive	DM15	1
C29	Capacitor, .1 μF	900001-013	Amperex	C280AE	1
C30	Capacitor, .01 μF	900001-001	Amperex	C280AE	1
C31	Capacitor, 2 pF	900003-002	Electromotive	DM15	1
C32	Capacitor, 82 pF	900003-029	Electromotive	DM15	1

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
C33	Capacitor, 470 pF	900003-047	Electromotive	DM15	1
C34	Capacitor, 470 pF	900003-047	Electromotive	DM15	1
C35	Capacitor, 10 pF	900003-008	Electromotive	DM15	1
C36	Capacitor, Variable, 1.7-11 pF	900113-002	JFD	DVJ-302A	1
C37	Capacitor, 1000 pF	900003-056	Electromotive	DM15	1
C38	Capacitor, .022 µF	900001-005	Amperex	C280AE	1
C39	Capacitor, .01 µF	900001-001	Amperex	C280AE	1
C41	Capacitor, 470 pF	900003-047	Electromotive	DM15	1
C42	Capacitor, 10 pF	900003-008	Electromotive	DM15	1
C43	Capacitor, Variable, 1.7-11 pF	900113-002	JFD	DVJ-302A	1
C44	Capacitor, 1000 pF	900003-056	Electromotive	DM15	1
C45	Capacitor, 1000 pF	900003-056	Electromotive	DM15	1
C46-C48	Not Used				0
C49	Capacitor, .1 µF	900001-013	Amperex	C280AE	1
L1	Coil	906006-003	Artted		1
L2	Choke, 10 µH	906022-005	J.W.Miller	70F105A1	1
L3-L5	Coil	906006-008	Artted		3
L6	Coil, 1/4" ID, 2-1/2T	402965-001	Singer		1
L7	Coil, 1/4" ID, 2-1/2T	402965-001	Singer		1
L8	Coil, 1/4" ID, 2-1/2T	402965-001	Singer		1
Q1, Q2	Transistor	958000-001	Motorola	2N3904	2
Q3	Transistor	958000-002	Motorola	2N3906	1
Q4	Transistor	958018-001	Motorola	2N5179	1
Q5	Transistor	958000-002	Motorola	2N3906	1
Q6, Q7	Transistor	958018-001	Motorola	2N5179	2
Q8	Transistor	958000-001	Motorola	2N3904	1
Q9	Not Used				0
Q10	Transistor	958018-001	Motorola	2N5179	1
Q11	Transistor	958018-001	Motorola	2N5179	1
R1	Resistor, 1 k	945000-037	Allen-Bradley	Type CB	1
R2	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R3	Resistor, 1 k	945000-037	Allen-Bradley	Type CB	1

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
R4	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R5	Resistor, 10 k	945000-049	Allen-Bradley	Type CB	1
R6	Resistor, 150 ohm	945000-027	Allen-Bradley	Type CB	1
R7	Resistor, 56 k	945000-058	Allen-Bradley	Type CB	1
R8	Resistor, 1.5 k	945000-039	Allen-Bradley	Type CB	1
R9	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R10	Resistor, 10 k	945000-049	Allen-Bradley	Type CB	1
R11	Resistor, 47 k	945000-057	Allen-Bradley	Type CB	1
R12	Resistor, 470 ohm	945000-033	Allen-Bradley	Type CB	1
R13	Resistor, 150 k	945000-063	Allen-Bradley	Type CB	1
R14, R15	Resistor, 220 ohm	945000-029	Allen-Bradley	Type CB	2
R16	Resistor, 150 ohm	945000-027	Allen-Bradley	Type CB	1
R17	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R18	Resistor, 1.5 k	945000-039	Allen-Bradley	Type CB	1
R19	Resistor, 1.2 k	945000-038	Allen-Bradley	Type CB	1
R20	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R21	Resistor, 15 k	945000-051	Allen-Bradley	Type CB	1
R22, R23	Resistor, 1 k	945000-037	Allen-Bradley	Type CB	2
R24, R25	Resistor, 15 k	945000-051	Allen-Bradley	Type CB	2
R26	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R27	Resistor, 3.9 k	945000-044	Allen-Bradley	Type CB	1
R28	Resistor, Selected, 330 ohm nominal	945000-031	Allen-Bradley	Type CB	1

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
R29	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R30	Resistor, 47 ohm	945000-021	Allen-Bradley	Type CB	1
R31	Resistor, 3.9 k	945000-044	Allen-Bradley	Type CB	1
R32	Resistor, 220 ohm	945000-029	Allen-Bradley	Type CB	1
R33	Resistor, 15 ohm	945000-015	Allen-Bradley	Type CB	1
R34	Resistor, 10 k	945000-049	Allen-Bradley	Type CB	1
R35	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R36-R38	Not Used				0
R39, R40	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	2
R41	Resistor, 180 ohm	945000-028	Allen-Bradley	Type CB	1
R42	Resistor, 3.9 k	945000-044	Allen-Bradley	Type CB	1
R43, R44	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	2
R45	Not Used				0
R46	Resistor, 1.2 k	945000-038	Allen-Bradley	Type CB	2
R47	Not Used				0
R49	Resistor, 680 ohm	945000-035	Allen-Bradley	Type CB	1
R50	Resistor, 680 ohm	945000-035	Allen-Bradley	Type CB	1
U1	Integrated Circuit	926018-001	Signetics Corp.	LU380A	1
Y1, Y2	Xtl, Freq., 4.5 MHz	912001-010	Singer		2

FREQUENCY GENERATOR ASSEMBLY A13

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
C1	Capacitor, .1 μF	900001-013	Amperex	C280AE	1
C2, C3	Capacitor, 22 pF	900003-013	Electromotive	DM15	2
C4	Capacitor, 10 pF	900003-008	Electromotive	DM15	1
C5	Capacitor, Variable, 1.7-11 pF	900113-002	JFD	DVJ-302A	1
C6	Capacitor, .01 μF	900001-001	Amperex	C280AE	1
C7	Capacitor, 470 pF	900003-047	Electromotive	DM15	1
C8	Capacitor, .1 μF	900001-013	Amperex	C280AE	1
C9	Capacitor, 43 pF	900003-020	Electromotive	DM15	1
C10	Capacitor, 1000 pF	900003 056	Electromotive	DM15	1
C11	Capacitor, 24 pF	900003-014	Electromotive	DM15	1
C12	Capacitor, 12 pF	900003-009	Electromotive	DM15	1
C13	Capacitor, .022 μF	900001-005	Amperex	C280AE	1
C14	Capacitor, 10 pF	900003-008	Electromotive	DM15	1
C15	Capacitor, .1 μF	900001-013	Amperex	C280AE	1
C16	Capacitor, 2 pF	900003-002	Electromotive	DM15	1
C17	Capacitor, .01 μF	900001-001	Amperex	C280AE	1
C18	Capacitor, 82 pF	900003-028	Electromotive	DM15	1
C19	Capacator, 470 pF	900003-047	Electromotive	DM15	1
C20	Capacitor, 1000 pF	900003-056	Electromotive	DM15	1
C21	Capacitor, 15 pF	900003-010	Electromotive	DM15	1
C22	Capacitor, 1000 pF	900003-056	Electromotive	DM15	1
C23	Capacitor, 470 pF	900003-047	Electromotive	DM15	1
C24	Capacitor, Variable, 1.7-11 pF	900113-002	JFD	DVJ-302A	1
C25	Capacitor, 82 pF	900003-028	Electromotive	DM15	1
C26	Capacitor, 470 pF	900003-047	Electromotive	DM15	1
C27	Capacitor, .1 μF	900001-013	Amperex	C280AE	1
C28	Capacitor, 15 pF	900003-010	Electromotive	DM15	1
C29	Capacitor, .1 μF	900001-013	Amperex	C280AE	1
C30	Capacitor, .01 μF	900001-001	Amperex	C280AE	1
C31	Capacitor, 2 pF	900003-002	Electromotive	DM15	1
C32	Capacitor, 82 pF	900003-029	Electromotive	DM15	1
C33	Capacitor, 470 pF	900003-047	Electromotive	DM15	1

FREQUENCY GENERATOR ASSEMBLY A13 (CONT)

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
C34	Capacitor, 470 pF	90000-047	Electromotive	DM15	1
C35	Capacitor, 15 pF	900003-010	Electromotive	DM15	1
C36	Capacitor, Variable, 1.7-11 pF	900113-002	JFD	DVJ-302A	1
C37	Capacitor, 1000 pF	900003-056	Electromotive	DM15	1
C38	Capacitor, .022 µF	900001-005	Amperex	C280AE	1
C39	Capacitor, .01 µF	900001-001	Amperex	C280AE	1
C41	Capacitor, 470 pF	900003-047	Electromotive	DM15	1
C42	Capacitor, 15 pF	900003-010	Electromotive	DM15	1
C43	Capacitor, Variable, 1.7-11 pF	900113-002	JFD	DVJ-302A	1
C44	Capacitor, 1000 pF	900003-056	Electromotive	DM15	1
C45	Capacitor, 1000 pF	900003-056	Electromotive	DM15	1
C46-C48	Not Used				0
C49	Capacitor, .1 µF	900001-013	Amperex	C280AE	1
L1	Coil	906006-003	Artted		1
L2	Choke, 10 µH	906022-005	J.W.Miller	70F105A1	1
L3-L5	Coil	906006-008	Artted		3
L6	Coil, 1/4" ID, 2-1/2T	402965-001	Singer		1
L7	Coil, 1/4" ID, 1-1/2T	402965-001	Singer		1
L8	Coil, 1/4" ID, 2-1/2T	402965-001	Singer		1
Q1, Q2	Transistor	958000-001	Motorola	2N3904	2
Q3	Transistor	958000-002	Motorola	2N3906	1
Q4	Transistor	958018-001	Motorola	2N5179	1
Q5	Transistor	958000-002	Motorola	2N3906	1
Q6, Q7	Transstor	958018-001	Motorola	2N5179	2
Q8	Transistor	958000-001	Motorola	2N3904	1
Q9	Not Used				0
Q10	Transistor	958018-001	Motorola	2N5179	1
Q11	Transistor	958018-001	Motorola	2N5179	1
R1	Resistor, 1 k	945000-037	Allen-Bradley	Type CB	1
R2	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R3	Resistor, 1 k	945000-037	Allen-Bradley	Type CB	1
R4	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
R5	Resistor, 10 k	945000-049	Allen-Bradley	Type CB	1
R6	Resistor, 150 ohm	945000-027	Allen-Bradley	Type CB	1
R7	Resistor, 56 k	945000-058	Allen-Bradley	Type CB	1
R8	Resistor, 1.5 k	945000-039	Allen-Bradley	Type CB	1
R9	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R10	Resistor, 10 k	945000-049	Allen-Bradley	Type CB	1
R11	Resistor, 47 k	945000-057	Allen-Bradley	Type CB	1
R12	Resistor, 470 ohm	945000-033	Allen-Bradley	Type CB	1
R13	Resistor, 150 k	945000-063	Allen-Bradley	Type CB	1
R14, R15	Resistor, 220 ohm	945000-029	Allen-Bradley	Type CB	2
R16	Resistor, 150 ohm	945000-027	Allen-Bradley	Type CB	1
R17	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R18	Resistor, 1.5 k	945000-039	Allen-Bradley	Type CB	1
R19	Resistor, 1.2 k	945000-038	Allen-Bradley	Type CB	1
R20	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R21	Resistor, 15 k	945000-051	Allen-Bradley	Type CB	1
R22, R23	Resistor, 1 k	945000-037	Allen-Bradley	Type CB	2
R24, R25	Resistor, 15 k	945000-051	Allen-Bradley	Type CB	2
R26	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R27	Resistor, 3.9 k	945000-044	Allen-Bradley	Type CB	1
R28	Resistor, Selected, 330 ohm nominal	945000-031	Allen-Bradley	Type CB	1

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
R29	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R30	Resistor, 47 ohm	945000-021	Allen-Bradley	Type CB	1
R31	Resistor, 3.9 k	945000-044	Allen-Bradley	Type CB	1
R32	Resistor, 220 ohm	945000-029	Allen-Bradley	Type CB	1
R33	Resistor, 15 ohm	945000-015	Allen-Bradley	Type CB	1
R34	Resistor, 10 k	945000-049	Allen-Bradley	Type CB	1
R35	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R36-R38	Not Used				0
R39, R40	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	2
R41	Resistor, Selected, 180 ohm nominal	945000-028	Allen-Bradley	Type CB	1
R42	Resistor, 3.9 k	945000-044	Allen-Bradley	Type CB	1
R43, R44	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	2
R45	Not Used				0
R46	Resistor, 1.2 k	945000-038	Allen-Bradley	Type CB	1
R47, R48	Not Used				0
R49	Resistor, 680 ohm	945000-035	Allen-Bradley	Type CB	1
R50	Resistor, 680 ohm	945000-035	Allen-Bradley	Type CB	1
U1	Inetgrated circuit	926018-001	Signetics Corp.	LU380A	1
Y1, Y2	Xtl, Freq., 4.4 MHz	912001-009	Singer		2

FREQUENCY GENERATOR ASSEMBLY A14

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
C1	Capacitor, .1 μF	900001-013	Amperex	C280AE	1
C2, C3	Capacitor, 22 pF	900003-013	Electromotive	DM15	2
C4	Capacitor, 10 pF	900003-008	Electromotive	DM15	1
C5	Capacitor, Variable, 1.7-11 pF	900113-002	JFD	DVJ-302A	1
C6	Capacitor, .01 μF	900001-001	Amperex	C280AE	1
C7	Capacitor, 470 pF	900003-047	Electromotive	DM15	1
C8	Capacitor, .1 μF	900001-013	Amperex	C280AE	1
C9	Capacitor, 43 pF	900003-020	Electromotive	DM15	1
C10	Capacitor, 1000 pF	900003-056	Electromotive	DM15	1
C11	Capacitor, 24 pF	900003-014	Electromotive	DM15	1
C12	Capacitor, 12 pF	900003-009	Electromotive	DM15	1
C13	Capacitor, .022 μF	900001-005	Amperex	C280AE	1
C14	Capacitor, 10 pF	900003-008	Electromotive	DM15	1
C15	Capacitor, .1 μF	900001-013	Amperex	C280AE	1
C16	Capacitor, 2 pF	900003-002	Electromotive	DM15	1
C17	Capacitor, .01 μF	900001-001	Amperex	C280AE	1
C18	Capacitor, 82 pF	900003-028	Electromotive	DM15	1
C19	Capacitor, 470 pF	900003-047	Electromotive	DM15	1
C20	Capacitor, 1000 pF	900003-056	Electromotive	DM15	1
C21	Capacitor, 18 pF	900003-011	Electromotive	DM15	1
C22	Capacitor, 1000 pF	900003-056	Electromotive	DM15	1
C23	Capacitor, 470 pF	900003-047	Electromotive	DM15	1
C24	Capacitor, Variable, 1.7-11 pF	900113-002	JFD	DVJ-302A	1
C25	Capacitor, 82 pF	900003-028	Electromotive	DM15	1

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
C26	Capacitor, 470 pF	900003-047	Electromotive	DM15	1
C27	Capacitor, .1 μF	900001-013	Amperex	C280AE	1
C28	Capacitor, 15 pF	900003-010	Electromotive	DM15	1
C29	Capacitor, .1 μF	900001-013	Amperex	C280AE	1
C30	Capacitor, .01 μF	900001-001	Amperex	C280AE	1
C31	Capacitor, 2 pF	900003-002	Electromotive	DM15	1
C32	Capacitor, 82 pF	900003-029	Electromotive	DM15	1
C33	Capacitor, 470 pF	900003-047	Electromotive	DM15	1
C34	Capacator, 470 pF	900003-047	Electromotive	DM15	1
C35	Capacitor, 18 pF	900003-011	Electromotive	DM15	1
C36	Capacitor, Variable, 1.7-11 pF	900113-002	JFD	DVJ-302A	1
C37	Capacitor, 1000 pF	900003-056	Electromotive	DM15	1
C38	Capacitor, .022 μF	900001-005	Amperex	C280AE	1
C39	Capacitor, .01 μF	900001-001	Amperex	C280AE	1
C40	Capacitor, 470 pF	900003-047	Electromotive	DM15	1
C41	Capacitor, 470 pF	900003-047	Electromotive	DM15	1
C42	Capacitor, 18 pF	900003-011	Electromotive	DM15	1
C43	Capacitor, Variable, 1.7-11 pF	900113-002	JFD	DVJ-302A	1
C44	Capacitor, 1000 pF	900003-056	Electromotive	DM15	1
C45	Capacitor, 1000 pF	900003-056	Electromotive	DM15	1
C47	Capacitor, 3 pF	900003-003	Electromotive	DM15	1
C49	Capacitor, .1	900001-013	Amperex	C280AE	1
L1	Coil	906006-003	Artted		1
L2	Choke, 10 μH	906022-005	J.W.Miller	70F105A1	1
L3-L5	Coil	906006-008	Artted		3
L6	Coil, 1/4" ID, 2-1/2T	402965-001	Singer		1
L7	Coil, 1/4" ID, 2-1/2T	402965-001	Singer		1
L8	Coil, 1/4" ID, 2-1/2T	402965-001	Singer		1
Q1,Q2	Transistor	958000-001	Motorola	2N3904	2
Q3	Transistor	958000-002	Motorola	2N3906	1
Q4	Transistor	958018-001	Motorola	2N5179	1

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
Q5	Transistor	958000-002	Motorola	2N3906	1
Q6, Q7	Transistor	958018-001	Motorola	2N5179	2
Q8	Transistor	958000-001	Motorola	2N3904	1
Q9	Not Used				0
Q10	Transistor	958018-001	Motorola	2N5179	1
Q11	Transistor	958018-001	Motorola	2N5179	1
R1	Resistor, 1 k	945000-037	Allen-Bradley	Type CB	1
R2	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R3	Resistor, 1 k	945000-037	Allen-Bradley	Type CB	1
R4	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R5	Resistor, 10 k	945000-049	Allen-Bradley	Type CB	1
R6	Resistor, 150 ohm	945000-027	Allen-Bradley	Type CB	1
R7	Resistor, 56 k	945000-058	Allen-Bradley	Type CB	1
R8	Resistor, 1.5 k	945000-039	Allen-Bradley	Type CB	1
R9	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R10	Resistor, 10 k	945000-049	Allen-Bradley	Type CB	1
R11	Resistor, 47 k	945000-057	Allen-Bradley	Type CB	1
R12	Resistor, 470 ohm	945000-033	Allen-Bradley	Type CB	1
R13	Resistor, 150 k	945000-063	Allen-Bradley	Type CB	1
R14, R15	Resistor, 220 ohm	945000-029	Allen-Bradley	Type CB	2
R16	Resistor, 150 ohm	945000-027	Allen-Bradley	Type CB	1
R17	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R18	Resistor, 1.5 k	945000-039	Allen-Bradley	Type CB	1
R19	Resistor, 1.2 k	945000-038	Allen-Bradley	Type CB	1
R20	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1

FREQUENCY GENERATOR ASSEMBLY A14 (CONT)

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
R21	Resistor, 15 k	945000-051	Allen-Bradley	Type CB	1
R22, R23	Resistor, 1 k	945000-037	Allen-Bradley	Type CB	2
R24, R25	Resistor, 15 k	945000-051	Allen-Bradley	Type CB	2
R26	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R27	Resistor, 3.9 k	945000-044	Allen-Bradley	Type CB	1
R28	Resistor, Selected, 330 ohm nominal	945000-031	Allen-Bradley	Type CB	1
R29	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R30	Resistor, 47 ohm	945000-021	Allen-Bradley	Type CB	1
R31	Resistor, 3.9 k	945000-044	Allen-Bradley	Type CB	1
R32	Resistor, 220 ohm	945000-029	Allen-Bradley	Type CB	1
R33	Resistor, 15 ohm	945000-015	Allen-Bradley	Type CB	1
R34	Resistor, 10 k	945000-049	Allen-Bradley	Type CB	1
R35	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R36-R38	Not Used				0
R39, R40	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	2
R41	Resistor, Selected, 180 ohm nominal	945000-028	Allen-Bradley	Type CB	1
R42	Resistor, 3.9 k	945000-044	Allen-Bradley	Type CB	1
R43, R44	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	2
R45	Not Used				0
R46	Resistor, 1.2 k	945000-038	Allen-Bradley	Type CB	1
R47, R48	Not Used				0
R49	Resistor, 680 ohm	945000-035	Allen-Bradley	Type CB	1
R50	Resistor, 680 ohm	945000-035	Allen-Bradley	Type CB	1
U1	Integrated circuit	926018-001	Signetics Corp.	LU380A	1
Y1, Y2	Xtl, Freq., 4.3 MHz	912001-008	Singer		2

FREQUENCY GENERATOR ASSEMBLY A15

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
C1	Capacitor, .1 μF	900001-013	Amperex	C280AE	1
C2, C3	Capacitor, 22 pF	900003-013	Electromotive	DM15	2
C4	Capacitor, 10 pF	900003-008	Electromotive	DM15	1
C5	Capacitor, Variable, 1.7-11 pF	900113-002	JFD	DVJ-302A	1
C6	Capacitor, .01 μF	900001-001	Amperex	C280AE	1
C7	Capacitor, 470 pF	900003-056	Electromotive	DM15	1
C8	Capacitor, .1 μF	900001-013	Amperex	C280AE	1
C9	Capacitor, 43 pF	900003-020	Electromotive	DM15	1
C10	Capacitor, 1000 pF	900003-056	Electromotive	DM15	1
C11	Capacitor, 24 pF	900003-014	Electromotive	DM15	1
C12	Capacitor, 12 pF	900003-009	Electromotive	DM15	1
C13	Capacitor, .022 μF	900001-005	Amperex	C280AE	1
C14	Capacitor, 10 pF	900003-008	Electromotive	DM15	1
C15	Capacitor, .1 μF	900001-013	Amperex	C280AE	1
C16	Capacitor, 2 pF	900003-002	Electromotive	DM15	1
C17	Capacitor, .01 μF	900001-001	Amperex	C280AE	1
C18	Capacitor, 91 pF	900003-029	Electromotive	DM15	1
C19	Capacitor, 470 pF	900003-047	Electromotive	DM15	1
C20	Capacitor, 1000 pF	900003-056	Electromotive	DM15	1
C21	Capacitor, 24 pF	900003-014	Electromotive	DM15	1
C22	Capacitor, 1000 pF	900003-056	Electromotive	DM15	1
C23	Capacitor, 470 pF	900003-047	Electromotive	DM15	1
C24	Capacitor, Variable, 1.7-11 pF	900113-002	JFD	DVJ-302A	1
C25	Capacitor, 91 pF	900003-029	Electromotive	DM15	1
C26	Capacitor, 470 pF	900003-047	Electromotive	DM15	1
C27	Capacitor, .1 μF	900001-013	Amperex	C280AE	1
C28	Capacitor, 15 pF	900003-010	Electromotive	DM15	1
C29	Capacitor, .1 μF	900001-013	Amperex	C280AE	1
C30	Capacitor, .01 μF	900001-001	Amperex	C280AE	1

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
C31	Capacitor, 2 pF	900003-002	Electromotive	DM-15	1
C32	Capacitor, 100 pF	900003-030	Electromotive	DM-15	1
C33	Capacitor, 470 pF	900003-047	Electromotive	DM-15	1
C34	Capacitor, 470 pF	900003-047	Electromotive	DM-15	1
C35	Capacitor, 24 pF	900003-014	Electromotive	DM-15	1
C36	Capacitor, Variable, 1.7-11 pF	900113-002	JFD	DVJ-302A	1
C37	Capacitor, 1000 pF	900003-056	Electromotive	DM-15	1
C38	Capacitor, .022 μF	900001-115	Amperex	C280AE	1
C39	Capacitor, .01 μF	900001-001	Amperex	C280AE	1
C40	Not used				0
C41	Capacitor, 470 pF	900003-047	Electromotive	DM-15	1
C42	Capacitor, 24 pF	900003-014	Electromotive	DM-15	1
C43	Capacitor, Variable, 1.7-11 pF	900113-002	JFD	DVJ-302A	1
C44	Capacitor, 1000 pF	900003-056	Electromotive	DM-15	1
C45	Capacitor, 1000 pF	900003-056	Electromotive	DM-15	1
C46	Not used				0
C47	Capacitor, Selected, 5 pF Nominal	900003-004	Electromotive	DM-15	1
C48	Not used				0
C49	Capacitor, .1 μF	900001-013	Amperex	C280AE	1
L1	Coil	906006-003	Artted		1
L2	Choke, 10 μH	906022-005	JW Miller	70F105A1	1
L3-L5	Coil	906006-008	Artted		3
L6	Coil, 1/4" ID, 2-1/2T	402965-001	Singer		1
L7	Coil, 1/4" ID, 2-1/2T	402965-001	Singer		1
L8	Coil, 1/4" ID, 2-1/2T	402965-001	Singer		1
Q1, Q2	Transistor	958000-001	Motorola	2N3904	2
Q3	Transistor	958000-002	Motorola	2N3906	1
Q4	Transistor	958018-001	Motorola	2N5179	1
Q5	Transistor	958000-002	Motorola	2N3906	1
Q6, Q7	Transistor	958018-001	Motorola	2N5179	2
Q8	Transistor	958000-001	Motorola	2N3904	1
Q9	Not used				0
Q10	Transistor	958018-001	Motorola	2N5179	1

FREQUENCY GENERATOR ASSEMBLY A15 (CONT)

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
Q11	Transistor	958018-001	Motorola	2N5179	1
R1	Resistor, 1k	945000-037	Allen-Bradley	Type CB	1
R2	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R3	Resistor, 1k	945000-037	Allen-Bradley	Type CB	1
R4	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R5	Resistor, 10k	945000-049	Allen-Bradley	Type CB	1
R6	Resistor, 150 ohm	945000-027	Allen-Bradley	Type CB	1
R7	Resistor, 56k	945000-058	Allen-Bradley	Type CB	1
R8	Resistor, 1.5k	945000-039	Allen-Bradley	Type CB	1
R9	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R10	Resistor, 10k	945000-049	Allen-Bradley	Type CB	1
R11	Resistor, 47k	945000-057	Allen-Bradley	Type CB	1
R12	Resistor, 470 ohm	945000-033	Allen-Bradley	Type CB	1
R13	Resistor, 150k	945000-063	Allen-Bradley	Type CB	1
R14, R15	Resistor, 220 ohm	945000-029	Allen-Bradley	Type CB	2
R16	Resistor, 150 ohm	945000-027	Allen-Bradley	Type CB	1
R17	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R18	Resistor, 1.5k	945000-039	Allen-Bradley	Type CB	1
R19	Resistor, 1.2k	945000-038	Allen-Bradley	Type CB	1
R20	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R21	Resistor, 15k	945000-051	Allen-Bradley	Type CB	1

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
R22, R23	Resistor, 1k	945000-037	Allen-Bradley	Type CB	2
R24, R25	Resistor, 15k	945000-051	Allen-Bradley	Type CB	2
R26	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R27	Resistor, 3.9k	945000-044	Allen-Bradley	Type CB	1
R28	Resistor, Selected, 330 ohm Nominal	945000-031	Allen-Bradley	Type CB	1
R29	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R30	Resistor, 47 ohm	945000-021	Allen-Bradley	Type CB	1
R31	Resistor, 3.9k	945000-044	Allen-Bradley	Type CB	1
R32	Resistor, 220 ohm	945000-029	Allen-Bradley	Type CB	1
R33	Resistor, 15 ohm	945000-015	Allen-Bradley	Type CB	1
R34	Resistor, 10k	945000-049	Allen-Bradley	Type CB	1
R35	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R36-R38	Not used				0
R39, R40	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	2
R41	Resistor, Selected, 180 ohm Nominal	945000-028	Allen-Bradley	Type CB	1
R42	Resistor, 3.9k	945000-044	Allen-Bradley	Type CB	1
R43, R44	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	2
R45	Not used				0
R46	Resistor, 1.2k	945000-038	Allen-Bradley	Type CB	1
R47, R48	Not used				0
R49	Resistor, 680 ohm	945000-035	Allen-Bradley	Type CB	1
R50	Resistor, 680 ohm	945000-035	Allen-Bradley	Type CB	1
U1	Integrated Circuit	926018-001	Signetics Corp.	LU380A	1
Y1, Y2	Xtl, Freq., 4.2 MHz	912001-007	Singer		2

FREQUENCY GENERATOR ASSEMBLY A16

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
C1	Capacitor, .1 μF	900001-013	Amperex	C280AE	1
C2, C3	Capacitor, 22 pF	900003-013	Electromotive	DM15	2
C4	Capacitor, 10 pF	900003-008	Electromotive	DM15	1
C5	Capacitor, Variable, 1.7-11 pF	900113-002	JFD	DVJ-302A	1
C6	Capacitor, .01 μF	900001-001	Amperex	C280AE	1
C7	Capacitor, 470 pF	900003-056	Electromotive	DM15	1
C8	Capacitor, .1 μF	900001-013	Amperex	C280AE	1
C9	Capacitor, 43 pF	900003-020	Electromotive	DM15	1
C10	Capacitor, 1000 pF	900003-056	Electromotive	DM15	1
C11	Capacitor, 24 pF	900003-014	Electromotive	DM15	1
C12	Capacitor, 12 pF	900003-009	Electromotive	DM15	1
C13	Capacitor, .022 μF	900001-005	Amperex	C280AE	1
C14	Capacitor, 10 pF	900003-008	Electromotive	DM15	1
C15	Capacitor, .1 μF	900001-013	Amperex	C280AE	1
C16	Capacitor, 5 pF	900003-004	Electromotive	DM15	1
C17	Capacitor .01 μF	900001-001	Amperex	C280AE	1
C18	Capacitor, 68 pF	900003-026	Electromotive	DM15	1
C19	Capacitor, 470 pF	900003-047	Electromotive	DM15	1
C20	Capacitor, 1000 pF	900003-056	Electromotive	DM15	1
C21	Capacitor, 15 pF	900003-010	Electromotive	DM15	1
C22	Capacitor, 1000 pF	900003-056	Electromotive	DM15	1
C23	Capacitor, 470 pF	900003-047	Electromotive	DM15	1
C24	Capacitor, Variable, 1.7-11 pF	900113-002	JFD	DVJ-302A	1
C25	Capacitor, 68 pF	900003-026	Electromotive	DM15	1
C26	Capacitor, 470 pF	900003-047	Electromotive	DM15	1
C27	Capacitor, .1 μF	900001-013	Amperex	C280AE	1
C28	Capacitor, 15 pF	900003-010	Electromotive	DM15	1
C29	Capacitor, .1 μF	900001-013	Amperex	C280AE	1

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
C30	Capacitor, .01 μF	900001-001	Amperex	C280AE	1
C31	Capacitor, 2 pF	900003-002	Electromotive	DM-15	1
C32	Capacitor, 82 pF	900003-028	Electromotive	DM-15	1
C33	Capacitor, 470 pF	900003-047	Electromotive	DM-15	1
C34	Capacitor, 470 pF	900003-047	Electromotive	DM-15	1
C35	Capacitor, 15 pF	900003-010	Electromotive	DM-15	1
C36	Capacitor, Variable, 1.7-11 pF	900113-002	JFD	DVJ-302A	1
C37	Capacitor, 1000 pF	900003-056	Electromotive	DM-15	1
C38	Capacitor, .002 μF	900001-005	Amperex	C280AE	1
C39	Capacitor, .01 μF	900001-001	Amperex	C280AE	1
C40	Capacitor, 470 pF	900003-047	Electromotive	DM-15	1
C41	Capacitor, 470 pF	900003-047	Electromotive	DM-15	1
C42	Capacitor, 15 pF	900003-010	Electromotive	DM-15	1
C43	Capacitor, Variable, 1.7-11 pF	900113-002	JFD	DVJ-302A	1
C44	Capacitor, 1000 pF	900003-056	Electromotive	DM-15	1
C45	Capacitor, 1000 pF	900003-056	Electromotive	DM-15	1
C46	Not used				0
C47	Capacitor, Selected, 5 pF Nominal	900003-004	Electromotive	DM-15	1
C48	Not used				0
C49	Capacitor, .1 μF	900003-013	Amperex	C280AE	1
L1	Coil	906006-003	Artted		1
L2	Choke, 10 μH	906022-025	J.W. Miller	70F105A1	1
L3-L5	Coil	906006-009	Artted		3
L6	Coil, 1/4" ID, 3-1/2T	402965-003	Singer		1
L7	Coil, 1/4" ID, 3-1/2T	402965-003	Singer		1
L8	Coil, 1/4" ID, 3-1/2T	402965-003	Singer		1
Q1, Q2	Transistor	958000-001	Motorola	2N3904	2
Q3	Transistor	958000-002	Motorola	2N3906	1
Q4	Transistor	958018-001	Motorola	2N5179	1
Q5	Transistor	958000-002	Motorola	2N3906	1
Q6, Q7	Transistor	958018-001	Motorola	2N5179	2
Q8	Transistor	958000-001	Motorola	2N3904	1
Q9	Not used				0

FREQUENCY GENERATOR ASSEMBLY A16 (CONT)

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
Q10	Transistor	958018-001	Motorola	2N5179	1
Q11	Transistor	958018-001	Motorola	2N5179	1
R1	Resistor, 1k	945000-037	Allen-Bradley	Type CB	1
R2	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R3	Resistor, 1k	945000-037	Allen-Bradley	Type CB	1
R4	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R5	Resistor, 10k	945000-049	Allen-Bradley	Type CB	1
R6	Resistor, 150 ohm	945000-027	Allen-Bradley	Type CB	1
R7	Resistor, 56k	945000-058	Allen-Bradley	Type CB	1
R8	Resistor, 1.5k	945000-039	Allen-Bradley	Type CB	1
R9	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R10	Resistor, 10k	945000-049	Allen-Bradley	Type CB	1
R11	Resistor, 47k	945000-057	Allen-Bradley	Type CB	1
R12	Resistor, 470 ohm	945000-033	Allen-Bradley	Type CB	1
R13	Resistor, 150k	945000-063	Allen-Bradley	Type CB	1
R14, R15	Resistor, 220 ohm	945000-029	Allen-Bradley	Type CB	2
R16	Resistor, 150 ohm	945000-027	Allen-Bradley	Type CB	1
R17	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R18	Resistor, 1.5k	945000-039	Allen-Bradley	Type CB	1
R19	Resistor, 1.2k	945000-038	Allen-Bradley	Type CB	1
R20	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
R21	Resistor, 15k	945000-051	Allen-Bradley	Type CB	1
R22, R23	Resistor, 1k	945000-037	Allen-Bradley	Type CB	2
R24, R25	Resistor, 15k	945000-051	Allen-Bradley	Type CB	2
R26	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R27	Resistor, 3.9k	945000-044	Allen-Bradley	Type CB	1
R28	Resistor, Selected, 330 ohm Nominal	945000-031	Allen-Bradley	Type CB	1
R29	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R30	Resistor, 47 ohm	945000-021	Allen-Bradley	Type CB	1
R31	Resistor, 3.9k	945000-044	Allen-Bradley	Type CB	1
R32	Resistor, 220 ohm	945000-029	Allen-Bradley	Type CB	1
R33	Resistor, 15 ohm	945000-015	Allen-Bradley	Type CB	1
R34	Resistor, 10k	945000-049	Allen-Bradley	Type CB	1
R35	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R36-R38	Not used				0
R39, R40	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	2
R41	Resistor, Selected, 180 ohm Nominal	945000-028	Allen-Bradley	Type CB	1
R42	Resistor, 3.9k	945000-044	Allen-Bradley	Type CB	1
R43, R44	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	2
R45	Not used				0
R46	Resistor, 1.2k	945000-038	Allen-Bradley	Type CB	1
R47, R48	Not used				0
R49	Resistor, 680 ohm	945000-035	Allen-Bradley	Type CB	1
R50	Resistor, 680 ohm	945000-035	Allen-Bradley	Type CB	1
U1	Integrated Circuit	926018-001	Signetics Corp.	LU380A	1
Y1, Y2	Xtl, Freq., 4.1 MHz	912001-006	Singer		2

FREQUENCY GENERATOR ASSEMBLY A17

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
C1	Capacitor, .1 μF	900001-013	Amperex	C280AE	1
C2, C3	Capacitor, 22 pF	900003-013	Electromotive	DM15	2
C4	Capacitor, 10 pF	900003-008	Electromotive	DM15	1
C5	Capacitor, Variable, 1.7-11 pF	900113-002	JFD	DVJ-302A	1
C6	Capacitor, .01 μF	900001-001	Amperex	C280AE	1
C7	Capacitor, 470 pF	900003-056	Electromotive	DM15	1
C8	Capacitor, .1 μF	900001-013	Amperex	C280AE	1
C9	Capacitor, 43 pF	900003-020	Electromotive	DM15	1
C10	Capacitor, 1000 pF	900003-056	Electromotive	DM15	1
C11	Capacitor, 24 pF	900003-014	Electromotive	DM15	1
C12	Capacitor, 12 pF	900003-009	Electromotive	DM15	1
C13	Capacitor, .022 μF	900001-005	Amperex	C280AE	1
C14	Capacitor, 10 pF	900003-008	Electromotive	DM15	1
C15	Capacitor, .1 μF	900001-013	Amperex	C280AE	1
C16	Capacitor, 5 pF	900003-004	Electromotive	DM15	1
C17	Capacitor, .01 μF	900001-001	Amperex	C280AE	1
C18	Capacitor, 68 pF	900003-026	Electromotive	DM15	1
C19	Capacitor, 470 pF	900003-047	Electromotive	DM15	1
C20	Capacitor, 1000 pF	900003-056	Electromotive	DM15	1
C21	Capacitor, 24 pF	900003-014	Electromotive	DM15	1
C22	Capacitor, 1000 pF	900003-056	Electromotive	DM15	1
C23	Capacitor, 470 pF	900003-047	Electromotive	DM15	1
C24	Capacitor, Variable, 1.7-11 pF	900113-002	JFD	DVJ-302A	1
C25	Capacitor, 68 pF	900003-026	Electromotive	DM15	1
C26	Capacitor, 470 pF	900003-047	Electromotive	DM15	1
C27	Capacitor, .1 μF	900001-013	Amperex	C280AE	1
C28	Capacitor, 15 pF	900003-010	Electromotive	DM15	1
C29	Capacitor, .1 μF	900001-013	Amperex	C280AE	1
C30	Capacitor, .01 μF	900001-001	Amperex	C280AE	1
C31	Capacitor, 2 pF	900003-002	Electromotive	DM15	1

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
C32	Capacitor, 82 pF	900003-028	Electromotive	DM15	1
C33	Capacitor, 470 pF	900003-047	Electromotive	DM15	1
C34	Capacitor, 470 pF	900003-047	Electromotive	DM15	1
C35	Capacitor, 24 pF	900003-014	Electromotive	DM15	1
C36	Capacitor, Variable, 1.7-11 pF	900113-002	JFD	DVJ-302A	1
C37	Capacitor, 1000 pF	900003-056	Electromotive	DM15	1
C38	Capacitor, .022 µF	900001-005	Amperex	C280AE	1
C39	Capacitor, .01 µF	900001-001	Amperex	C280AE	1
C40	Capacitor, 470 pF	900003-047	Electromotive	DM15	1
C41	Capacitor, 470 pF	900003-047	Electromotive	DM15	1
C42	Capacitor, 24 pF	900003-014	Electromotive	DM15	1
C43	Capacitor, Variable 1.7-11 pF	900113-002	JFD	DVJ-302A	1
C44, C45	Capacitor, 1000 pF	900003-056	Electromotive	DM15	1
C46	Not used				0
C47	Capacitor, Selected, 10 pF Nominal	900003-008	Electromotive	DM15	1
C48	Not used				0
C49	Capacitor, .1 µF	900001-013	Amperex	C280AE	1
L1	Coil	906006-003	Artted		1
L2	Choke, 10 µH	906022-025	J. W. Miller	70F105A1	1
L3-L5	Coil	906006-009	Artted		3
L6	Coil, 1/4" ID, 3-1/2T	402965-003	Singer		1
L7	Coil, 1/4" ID, 3-1/2T	402965-003	Singer		1
L8	Coil, 1/4" ID, 3-1/2T	402965-003	Singer		1
Q1,Q2	Transistor	958000-001	Motorola	2N3904	2
Q3	Transistor	958000-002	Motorola	2N3906	1
Q4	Transistor	958018-001	Motorola	2N5179	1
Q5	Transistor	958000-002	Motorola	2N3906	1
Q6, Q7	Transistor	958018-001	Motorola	2N5179	2
Q8	Transistor	958000-001	Motorola	2N3904	1
Q9	Not used				0
Q10	Transistor	958018-001	Motorola	2N5179	1
Q11	Transistor	958018-001	Motorola	2N5179	1

FREQUENCY GENERATOR ASSEMBLY A17 (CONT)

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
R1	Resistor, 1k	945000-037	Allen-Bradley	Type CB	1
R2	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R3	Resistor, 1k	945000-037	Allen-Bradley	Type CB	1
R4	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R5	Resistor, 10k	945000-049	Allen-Bradley	Type CB	1
R6	Resistor, 150 ohm	945000-027	Allen-Bradley	Type CB	1
R7	Resistor, 56k	945000-058	Allen-Bradley	Type CB	1
R8	Resistor, 1.5k	945000-039	Allen-Bradley	Type CB	1
R9	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R10	Resistor, 10k	945000-049	Allen-Bradley	Type CB	1
R11	Resistor, 47k	945000-057	Allen-Bradley	Type CB	1
R12	Resistor, 470 ohm	945000-033	Allen-Bradley	Type CB	1
R13	Resistor, 150k	945000-063	Allen-Bradley	Type CB	1
R14, R15	Resistor, 220 ohm	945000-029	Allen-Bradley	Type CB	2
R16	Resistor, 150 ohm	945000-027	Allen-Bradley	Type CB	1
R17	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R18	Resistor, 1.5k	945000-039	Allen-Bradley	Type CB	1
R19	Resistor, 1.2k	945000-038	Allen-Bradley	Type CB	1
R20	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R21	Resistor, 15k	945000-051	Allen-Bradley	Type CB	1
R22, R23	Resistor, 1k	945000-037	Allen-Bradley	Type CB	2

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
R24, R25	Resistor, 15k	945000-051	Allen-Bradley	Type CB	2
R26	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R27	Resistor, 3.9k	945000-044	Allen-Bradley	Type CB	1
R28	Resistor, Selected, 330 ohm Nominal	945000-031	Allen-Bradley	Type CB	1
R29	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R30	Resistor, 47 ohm	945000-021	Allen-Bradley	Type CB	1
R31	Resistor, 3.9k	945000-044	Allen-Bradley	Type CB	1
R32	Resistor, 220 ohm	945000-029	Allen-Bradley	Type CB	1
R33	Resistor, 15 ohm	945000-015	Allen-Bradley	Type CB	1
R34	Resistor, 10k	945000-049	Allen-Bradley	Type CB	1
R35	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R36-R38	Not used				0
R39, R40	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	2
R41	Resistor, Selected, 180 ohm Nominal	945000-028	Allen-Bradley	Type CB	1
R42	Resistor, 3.9k	945000-044	Allen-Bradley	Type CB	1
R43, R44	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	2
R45	Not used				0
R46	Resistor, 1.2k	945000-038	Allen-Bradley	Type CB	1
R47, R48	Not used				0
R49	Resistor, 680 ohm	945000-035	Allen-Bradley	Type CB	1
R50	Resistor, 680 ohm	945000-035	Allen-Bradley	Type CB	1
U1	Integrated Circuit	926018-001	Signetics Corp.	LU380A	1
Y1, Y2	Xtl, Freq., 4.0 MHz	912001-005	Singer		2

FREQUENCY GENERATOR ASSEMBLY A18

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
C1	Capacitor, .1 μF	900001-013	Amperex	C280AE	1
C2, C3	Capacitor, 22 pF	900003-013	Electromotive	DM15	2
C4	Capacitor, 10 pF	900003-008	Electromotive	DM15	1
C5	Capacitor, Variable, 1.7-11 pF	900113-002	JFD	DVJ-302A	1
C6	Capacitor, .01 μF	900001-001	Amperex	C280AE	1
C7	Capacitor, 470 pF	900003-056	Electromotive	DM15	1
C8	Capacitor, .1 μF	900001-013	Amperex	C280AE	1
C9	Capacitor, 43 pF	900003-020	Electromotive	DM15	1
C10	Capacitor, 1000 pF	900003-056	Electromotive	DM15	1
C11	Capacitor, 24 pF	900003-014	Electromotive	DM15	1
C12	Capacitor, 12 pF	900003-009	Electromotive	DM15	1
C13	Capacitor, .022 μF	900001-005	Amperex	C280AE	1
C14	Capacitor, 10 pF	900003-008	Electromotive	DM15	1
C15	Capacitor, .1 μF	900001-013	Amperex	C280AE	1
C16	Capacitor, 5 pF	900003-004	Electromotive	DM15	1
C17	Capacitor, .01 μF	900001-001	Amperex	C280AE	1
C18	Capacitor, 68 pF	900003-026	Electromotive	DM15	1
C19	Capacitor, 470 pF	900003-047	Electromotive	DM15	1
C20	Capacitor, 10 pF	900003-056	Electromotive	DM15	1
C21	Capacitor, 33 pF	900003-017	Electromotive	DM15	1
C22	Capacitor, 1000 pF	900003-056	Electromotive	DM15	1
C23	Capacitor, 470 pF	90003-047	Electromotive	DM15	1
C24	Capacitor, Variable, 1.7-11 pF	900113-002	JFD	DVJ-302A	1
C25	Capacitor, 68 pF	900003-026	Electromotive	DM15	1
C26	Capacitor, 470 pF	900003-047	Electromotive	DM15	1
C27	Capacitor, .1 μF	900001-013	Amperex	C280AE	1
C28	Capacitor, 15 pF	900003-010	Electromotive	DM15	1
C29	Capacitor, .1 μF	900001-013	Amperex	C280AE	1
C30	Capacitor, .01 μF	900001-001	Amperex	C280AE	1
C31	Capacitor, 2 pF	900003-002	Electromotive	DM15	1

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
C32	Capacitor, 82 pF	900003-028	Electromotive	DM-15	1
C33	Capacitor, 470 pF	900003-047	Electromotive	DM-15	1
C34	Capacitor, 470 pF	900003-047	Electromotive	DM-15	1
C35	Capacitor, 33 pF	900003-017	Electromotive	DM-15	1
C36	Capacitor, Variable, 1.7-11 pF	900113-002	JFD	DVJ-302A	1
C37	Capacitor, 1000 pF	900003-056	Electromotive	DM-15	1
C38	Capacitor, .022 μF	900001-005	Amperex	C280AE	1
C39	Capacitor, .01 μF	900001-001	Amperex	C280AE	1
C40	Capacitor, 470 pF	900003-047	Electromotive	DM-15	1
C41	Capacitor, 470 pF	900003-047	Electromotive	DM-15	1
C42	Capacitor, 33 pF	900003-017	Electromotive	DM-15	1
C43	Capacitor, Variable, 1.7-11 pF	900113-002	JFD	DVJ-302A	1
C44	Capacitor, 1000 pF	900003-056	Electromotive	DM-15	1
C45	Capacitor, 1000 pF	900003-056	Electromotive	DM-15	1
C46	Not used				0
C47	Capacitor, 12 pF	900003-009	Electromotive	DM-15	1
C48	Not used				0
C49	Capacitor .1 μF	900001-013	Amperex	C280AE	1
L1	Coil	906006-003	Artted		1
L2	Choke, 10 μH	906022-025	J.W. Miller	70F105A1	1
L3-L5	Coil	906006-009	Artted		3
L6	Coil 1/4" ID, 3-1/2T	402965-003	Singer		1
L7	Coil 1/4" ID, 3-1/2T	402965-003	Singer		1
L8	Coil 1/4" ID, 3-1/2T	402965-003	Singer		1
Q1, Q2	Transistor	958000-001	Motorola	2N3904	2
Q3	Transistor	958000-002	Motorola	2N3906	1
Q4	Transistor	958018-001	Motorola	2N5179	1
Q5	Transistor	958000-002	Motorola	2N3906	1
Q6, Q7	Transistor	958018-001	Motorola	2N5179	2
Q8	Transistor	958000-001	Motorola	2N3904	1
Q9	Not used				0
Q10	Transistor	958018-001	Motorola	2N5179	1
Q11	Transistor	958018-001	Motorola	2N5179	1
R1	Resistor, 1k	945000-037	Allen-Bradley	Type CB	1
R2	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
R3	Resistor, 1k	945000-037	Allen-Bradley	Type CB	1
R4	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R5	Resistor, 10k	945000-049	Allen-Bradley	Type CB	1
R6	Resistor, 150 ohm	945000-027	Allen-Bradley	Type CB	1
R7	Resistor, 56k	945000-058	Allen-Bradley	Type CB	1
R8	Resistor, 1.5k	945000-039	Allen-Bradley	Type CB	1
R9	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R10	Resistor, 10k	945000-049	Allen-Bradley	Type CB	1
R11	Resistor, 47k	945000-057	Allen-Bradley	Type CB	1
R12	Resistor, 470 ohm	945000-033	Allen-Bradley	Type CB	1
R13	Resistor, 150k	945000-063	Allen-Bradley	Type CB	1
R14, R15	Resistor, 220 ohm	945000-029	Allen-Bradley	Type CB	2
R16	Resistor, 150 ohm	945000-027	Allen-Bradley	Type CB	1
R17	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R18	Resistor, 1.5k	945000-039	Allen-Bradley	Type CB	1
R19	Resistor, 1.2k	945000-038	Allen-Bradley	Type CB	1
R20	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R21	Resistor, 15k	945000-051	Allen-Bradley	Type CB	1
R22, R23	Resistor, 1k	945000-037	Allen-Bradley	Type CB	2
R24, R25	Resistor, 15k	945000-051	Allen-Bradley	Type CB	2
R26	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1

FREQUENCY GENERATOR ASSEMBLY A18 (CONT)

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
R27	Resistor, 3.9k	945000-044	Allen-Bradley	Type CB	1
R28	Resistor, Selected, 330 ohm Nominal	945000-031	Allen-Bradley	Type CB	1
R29	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R30	Resistor, 47 ohm	945000-021	Allen-Bradley	Type CB	1
R31	Resistor, 3.9k	945000-044	Allen-Bradley	Type CB	1
R32	Resistor, 220 ohm	945000-029	Allen-Bradley	Type CB	1
R33	Resistor, 15 ohm	945000-015	Allen-Bradley	Type CB	1
R34	Resistor, 10k	945000-049	Allen-Bradley	Type CB	1
R35	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R36-R38	Not used				0
R39, R40	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	2
R41	Resistor, Selected, 180 ohm Nominal	945000-028	Allen-Bradley	Type CB	1
R42	Resistor, 3.9k	945000-044	Allen-Bradley	Type CB	1
R43, R44	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	2
R45	Not used				0
R46	Resistor, 1.2k	945000-038	Allen-Bradley	Type CB	1
R47, R48	Not used				0
R49	Resistor, 680 ohm	945000-035	Allen-Bradley	Type CB	1
U1	Integral Circuit	926018-001	Signetics Corp.	LU380A	1
Y1, Y2	Xtl, Freq., 3.9 MHz	912001-004	Singer		2

FREQUENCY GENERATOR ASSEMBLY A19

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
C1	Capacitor, .1 μF	900001-013	Amperex	C280AE	1
C2, C3	Capacitor, 22 pF	900003-013	Electromotive	DM15	2
C4	Capacitor, 10 pF	900003-008	Electromotive	DM15	1
C5	Capacitor, Variable, 1.7-11 pF	900113-002	JFD	DVJ-302A	1
C6	Capacitor, .01 μF	900001-001	Amperex	C280AE	1
C7	Capacitor, 470 pF	900003-056	Electromotive	DM15	1
C8	Capacitor, .1 μF	900001-013	Amperex	C280AE	1
C9	Capacitor, 43 pF	900003-020	Electromotive	DM15	1
C10	Capacitor, 1000 pF	900003-056	Electromotive	DM15	1
C11	Capacitor, 24 pF	900003-014	Electromotive	DM15	1
C12	Capacitor, 12 pF	900003-009	Electromotive	DM15	1
C13	Capacitor, .022 μF	900001-005	Amperex	C280AE	1
C14	Capacitor, 10 pF	900003-008	Electromotive	DM15	1
C15	Capacitor, .1 μF	900001-013	Amperex	C280AE	1
C16	Capacitor, 5 pF	900003-004	Electromotive	DM15	1
C17	Capacitor, .01 μF	900001-001	Amperex	C280AE	1
C18	Capacitor, 68 pF	900003-026	Electromotive	DM15	1
C19	Capacitor, 470 pF	900003-047	Electromotive	DM15	1
C20	Capacitor, 1000 pF	900003-056	Electromotive	DM15	1
C21	Capacitor, 43 pF	900003-020	Electromotive	DM15	1
C22	Capacitor, 1000 pF	900003-056	Electromotive	DM15	1
C23	Capacitor, 470 pF	900003-047	Electromotive	DM15	1
C24	Capacitor, Variable, 1.7-11 pF	900113-002	JFD	DVJ-302A	1
C25	Capacitor, 68 pF	900003-026	Electromotive	DM15	1
C26	Capacitor, 680 pF	900003-052	Electromotive	DM15	1
C27	Capacitor, .1 μF	900001-013	Amperex	C280AE	1
C28	Capacitor, 15 pF	900003-010	Electromotive	DM15	1
C29	Capacitor, .1 μF	900001-013	Amperex	C280AE	1
C30	Capacitor, .01 μF	900001-001	Amperex	C280AE	1
C31	Capacitor, 2 pF	900003-002	Electromotive	DM15	1
C32	Capacitor, 82 pF	900003-028	Electromotive	DM15	1

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
C33	Capacitor, 470 pF	900003-047	Electromotive	DM-15	1
C34	Capacitor, 470 pF	900003-047	Electromotive	DM-15	1
C35	Capacitor, 43 pF	900003-020	Electromotive	DM-15	1
C36	Capacitor, Variable, 1.7-11 pF	900113-002	JFD	DVJ-302A	1
C37	Capacitor, 1000 pF	900003-056	Electromotive	DM-15	1
C38	Capacitor, .022 μF	900001-005	Amperex	C280AE	1
C39	Capacitor, .01 μF	900001-001	Amperex	C280AE	1
C40	Capacitor, 470 pF	900003-047	Electromotive	DM-15	1
C41	Capacitor, 470 pF	900003-047	Electromotive	DM-15	1
C42	Capacitor, 43 pF	900003-020	Electromotive	DM-15	1
C43	Capacitor, Variable, 1.7-11 pF	900113-002	JFD	DVJ-302A	1
C44	Capacitor, 1000 pF	900003-056	Electromotive	DM-15	1
C45	Capacitor, 1000 pF	900003-056	Electromotive	DM-15	1
C46, 48	Not used				0
C47	Capacitor, 12 pF	900003-009	Electromotive	DM-15	1
C49	Capacitor, 1 μF	900001-013	Amperex	C280AE	1
L1	Coil	906006-003	Artted		1
L2	Choke, 10 μH	906022-025	J. W. Miller	70F105A1	1
L3-L5	Coil	906006-009	Artted		3
L6	Coil, 1/4" ID, 3-1/2T	402965-003	Singer		1
L7	Coil, 1/4" ID, 3-1/2T	402965-003	Singer		1
L8	Coil, 1/4" ID, 3-1/2T	402965-003	Singer		1
Q1, Q2	Transistor	958000-001	Motorola	2N3904	2
Q3	Transistor	958000-002	Motorola	2N3906	1
Q4	Transistor	958018-001	Motorola	2N5179	1
Q5	Transistor	958000-002	Motorola	2N3906	1
Q6, Q7	Transistor	958018-001	Motorola	2N5179	2
Q8	Transistor	958000-001	Motorola	2N3904	1
Q9	Not used				0
Q10	Transistor	958018-001	Motorola	2N5179	1
Q11	Transistor	958018-001	Motorola	2N5179	1
R1	Resistor, 1k	945000-037	Allen-Bradley	Type CB	1

FREQUENCY GENERATOR ASSEMBLY A19 (CONT)

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
R2	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R3	Resistor, 1k	945000-037	Allen-Bradley	Type CB	1
R4	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R5	Resistor, 10k	945000-049	Allen-Bradley	Type CB	1
R6	Resistor, 150 ohm	945000-027	Allen-Bradley	Type CB	1
R7	Resistor, 56k	945000-058	Allen-Bradley	Type CB	1
R8	Resistor, 1.5k	945000-039	Allen-Bradley	Type CB	1
R9	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R10	Resistor, 10k	945000-049	Allen-Bradley	Type CB	1
R11	Resistor, 47k	945000-057	Allen-Bradley	Type CB	1
R12	Resistor, 470 ohm	945000-033	Allen-Bradley	Type CB	1
R13	Resistor, 150k	945000-063	Allen-Bradley	Type CB	1
R14, R15	Resistor, 220 ohm	945000-029	Allen-Bradley	Type CB	2
R16	Resistor, 150 ohm	945000-027	Allen-Bradley	Type CB	1
R17	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R18	Resistor, 1.5k	945000-039	Allen-Bradley	Type CB	1
R19	Resistor, 1.2k	945000-038	Allen-Bradley	Type CB	1
R20	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R21	Resistor, 15k	945000-051	Allen-Bradley	Type CB	1
R22, R23	Resistor, 1k	945000-037	Allen-Bradley	Type CB	2
R24, R25	Resistor, 15k	945000-051	Allen-Bradley	Type CB	2

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
R26	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R27	Resistor, 3.9k	945000-044	Allen-Bradley	Type CB	1
R28	Resistor, Selected; 330 ohm Nominal	945000-031	Allen-Bradley	Type CB	1
R29	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R30	Resistor, 47 ohm	945000-021	Allen-Bradley	Type CB	1
R31	Resistor, 3.9k	945000-044	Allen-Bradley	Type CB	1
R32	Resistor, 220 ohm	945000-029	Allen-Bradley	Type CB	1
R33	Resistor, 15 ohm	945000-015	Allen-Bradley	Type CB	1
R34	Resistor, 10k	945000-049	Allen-Bradley	Type CB	1
R35	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R36-R38	Not used				0
R39, R40	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	2
R41	Resistor, Selected, 180 ohm Nominal	945000-028	Allen-Bradley	Type CB	1
R42	Resistor, 3.9k	945000-044	Allen-Bradley	Type CB	1
R43, R44	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	2
R45	Not used				0
R46	Resistor, 1.2k	945000-038	Allen-Bradley	Type CB	1
R47, R48	Not used				0
R49	Resistor, 680 ohm	945000-035	Allen-Bradley	Type CB	1
R50	Resistor, 680 ohm	945000-035	Allen-Bradley	Type CB	1
U1	Integrated Circuit	926018-001	Signetics Corp.	LU380A	1
Y1, Y2	Xtl, Freq., 3.8 MHz	912001-003	Singer		2

FREQUENCY GENERATOR ASSEMBLY A20

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
C1	Capacitor, .1 μF	900001-013	Amperex	C280AE	1
C2, C3	Capacitor, 22 pF	900003-013	Electromotive	DM15	2
C4	Capacitor, 10 pF	900003-008	Electromotive	DM15	1
C5	Capacitor, Variable, 1.7-11 pF	900113-002	JFD	DVJ-302A	1
C6	Capacitor, .01 μF	900001-001	Amperex	C280AE	1
C7	Capacitor, 470 pF	900003-056	Electromotive	DM15	1
C8	Capacitor, .1 μF	900001-013	Amperex	C280AE	1
C9	Capacitor, 43 pF	900003-020	Electromotive	DM15	1
C10	Capacitor, 1000 pF	900003-056	Electromotive	DM15	1
C11	Capacitor, 24 pF	900003-014	Electromotive	DM15	1
C12	Capacitor, 12 pF	900003-009	Electromotive	DM15	1
C13	Capacitor, .022 μF	900001-005	Amperex	C280AE	1
C14	Capacitor, 10 pF	900003-008	Electromotive	DM15	1
C15	Capacitor, .1 μF	900001-013	Amperex	C280AE	1
C16	Capacitor, 5 pF	900003-004	Electromotive	DM15	1
C17	Capacitor, .01 μF	900001-001	Amperex	C280AE	1
C18	Capacitor, 68 pF	900003-026	Electromotive	DM15	1
C19	Capacitor, 680 pF	900003-052	Electromotive	DM15	1
C20	Capacitor, 1000 pF	900003-056	Electromotive	DM15	1
C21	Capacitor, 56 pF	900003-024	Electromotive	DM15	1
C22	Capacitor, 1000 pF	900003-056	Electromotive	DM15	1
C23	Capacitor, 470 pF	900003-047	Electromotive	DM15	1
C24	Capacitor, Variable, 1.7-11 pF	900113-002	JFD	DVJ-302A	1
C25	Capacitor, 68 pF	900003-026	Electromotive	DM15	1
C26	Capacitor, 680 pF	900003-052	Electromotive	DM15	1
C27	Capacitor, .1 μF	900001-013	Amperex	C280AE	1
C28	Capacitor, 15 pF	900003-010	Electromotive	DM15	1
C29	Capacitor, .1 μF	900001-013	Amperex	C280AE	1
C30	Capacitor, .01 μF	900001-001	Amperex	C280AE	1
C31	Capacitor, 2 pF	900003-002	Electromotive	DM15	1
C32	Capacitor, 82 pF	900003-028	Electromotive	DM15	1
C33	Capacitor, 470 pF	900003-047	Electromotive	DM15	1

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
C34	Capacitor, 470 pF	900003-047	Electromotive	DM-15	1
C35	Capacitor, 56 pF	900003-024	Electromotive	DM-15	1
C36	Capacitor, Variable, 1.7-11 pF	900113-002	JFD	DVJ-302A	1
C37	Capacitor, 1000 pF	900003-056	Electromotive	DM-15	1
C38	Capacitor, .022 μF	900001-005	Amperex	C280AE	1
C39	Capacitor, .01 μF	900001-001	Amperex	C280AE	1
C40	Capacitor, 470 pF	900003-047	Electromotive	DM-15	1
C41	Capacitor, 470 pF	900003-047	Electromotive	DM-15	1
C42	Capacitor, 56 pF	900003-024	Electromotive	DM-15	1
C43	Capacitor, Variable, 1.7-11 pF	900113-002	JFD	DVJ-302A	1
C44	Capacitor, 1000 pF	900003-056	Electromotive	DM-15	1
C45	Capacitor, 1000 pF	900003-056	Electromotive	DM-15	1
C46	Not used				0
C47	Capacitor, 15 pF	900003-010	Electromotive	DM-15	1
C48	Not used				0
C49	Capacitor, .1 μF	900001-013	Amperex	C280AE	1
L1	Coil	906006-003	Artted		1
L2	Choke, 10 μH	906022-005	J.W. Miller	70F105A1	1
L3-L5	Coil	906006-009	Artted		3
L6	Coil, 1/4" ID, 3-1/2T	402965-003	Singer		1
L7	Coil, 1/4" ID, 3-1/2T	402965-003	Singer		1
L8	Coil, 1/4" ID, 3-1/2T	402965-003	Singer		1
Q1, Q2	Transistor	958000-001	Motorola	2N3904	2
Q3	Transistor	958000-002	Motorola	2N3906	1
Q4	Transistor	958018-001	Motorola	2N5179	1
Q5	Transistor	958000-002	Motorola	2N3906	1
Q6, Q7	Transistor	958018-001	Motorola	2N5179	2
Q8	Transistor	958000-001	Motorola	2N3904	1
Q9	Not used				0
Q10	Transistor	958018-001	Motorola	2N5179	1
Q11	Transistor	958018-001	Motorola	2N5179	1
R1	Resistor, 1k	945000-037	Allen-Bradley	Type CB	1
R2	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1

FREQUENCY GENERATOR ASSEMBLY A20 (CONT)

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
R3	Resistor, 1k	945000-037	Allen-Bradley	Type CB	1
R4	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R5	Resistor, 10k	945000-049	Allen-Bradley	Type CB	1
R6	Resistor, 150 ohm	945000-027	Allen-Bradley	Type CB	1
R7	Resistor, 56k	945000-058	Allen-Bradley	Type CB	1
R8	Resistor, 1.5k	945000-039	Allen-Bradley	Type CB	1
R9	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R10	Resistor, 10k	945000-049	Allen-Bradley	Type CB	1
R11	Resistor, 47k	945000-057	Allen-Bradley	Type CB	1
R12	Resistor, 470 ohm	945000-033	Allen-Bradley	Type CB	1
R13	Resistor, 150k	945000-063	Allen-Bradley	Type CB	1
R14, R15	Resistor, 220 ohm	945000-029	Allen-Bradley	Type CB	2
R16	Resistor, 150 ohm	945000-027	Allen-Bradley	Type CB	1
R17	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R18	Resistor, 1.5k	945000-039	Allen-Bradley	Type CB	1
R19	Resistor, 1.2k	945000-038	Allen-Bradley	Type CB	1
R20	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R21	Resistor, 15k	945000-051	Allen-Bradley	Type CB	1
R22, R23	Resistor, 1k	945000-037	Allen-Bradley	Type CB	2
R24, R25	Resistor, 15k	945000-051	Allen-Bradley	Type CB	2

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
R26	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R27	Resistor, 3.9k	945000-044	Allen-Bradley	Type CB	1
R28	Resistor, Selected, 330 ohm Nominal	945000-031	Allen-Bradley	Type CB	1
R29	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R30	Resistor, 47 ohm	945000-021	Allen-Bradley	Type CB	1
R31	Resistor, 3.9k	945000-044	Allen-Bradley	Type CB	1
R32	Resistor, 220 ohm	945000-029	Allen-Bradley	Type CB	1
R33	Resistor, 15 ohm	945000-015	Allen-Bradley	Type CB	1
R34	Resistor, 10k	945000-049	Allen-Bradley	Type CB	1
R35	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R36-R38	Not used				0
R39, R40	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	2
R41	Resistor, 180 ohm	945000-028	Allen-Bradley	Type CB	1
R42	Resistor, 3.9k	945000-044	Allen-Bradley	Type CB	1
R43, R44	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	2
R45	Not used				0
R46	Resistor, 1.2k	945000-038	Allen-Bradley	Type CB	1
R47, R48	Not used				0
R49	Resistor, 680 ohm	945000-035	Allen-Bradley	Type CB	1
R50	Resistor, 680 ohm	945000-035	Allen-Bradley	Type CB	1
U1	Integrated Circuit	926018-001	Signetics Corp.	LU380A	1
Y1, Y2	Xtl, Freq., 3.7 MHz	912001-002	Singer		2

FREQUENCY GENERATOR ASSEMBLY A21

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
C1	Capacitor, .1 μF	900001-013	Amperex	C280AE	1
C2, C3	Capacitor, 22 pF	900003-013	Electromotive	DM-15	2
C4	Capacitor, 10 pF	900003-008	Electromotive	DM-15	1
C5	Capacitor, Variable, 1.7-11 pF	900113-002	JFD	DVJ-302A	1
C6	Capacitor, .01 μF	900001-001	Amperex	C280AE	1
C7	Capacitor, 470 pF	900003-056	Electromotive	DM-15	1
C8	Capacitor, .1 μF	900001-013	Amperex	C280AE	1
C9	Capacitor, 43 pF	900003-020	Electromotive	DM-15	1
C10	Capacitor, 1000 pF	900003-056	Electromotive	DM-15	1
C11	Capacitor, 24 pF	900003-014	Electromotive	DM-15	1
C12	Capacitor, 12 pF	900003-009	Electromotive	DM-15	1
C13	Capacitor, .022 μF	900001-005	Amperex	C280AE	1
C14	Capacitor, 10 pF	900003-008	Electromotive	DM-15	1
C15	Capacitor, .1 μF	900001-013	Amperex	C280AE	1
C16	Capacitor, 5 pF	900003-004	Electromotive	DM-15	1
C17	Capacitor, .01 μF	900001-001	Amperex	C280AE	1
C18	Capacitor, 68 pF	900003-026	Electromotive	DM-15	1
C19	Capacitor, 680 pF	900003-052	Electromotive	DM-15	1
C20	Capacitor, 1000 pF	900003-056	Electromotive	DM-15	1
C21	Capacitor, 56 pF	900003-024	Electromotive	DM-15	1
C22	Capacitor, 1000 pF	900003-056	Electromotive	DM-15	1
C23	Capacitor, 470 pF	900003-047	Electromotive	DM-15	1
C24	Capacitor, Variable, 1.7-11 pF	900113-002	JFD	DVJ-302A	1
C25	Capacitor, 68 pF	900003-026	Electromotive	DM-15	1
C26	Capacitor, 680 pF	900003-052	Electromotive	DM-15	1
C27	Capacitor, .1 μF	900001-013	Amperex	C280AE	1
C28	Capacitor, 15 pF	900003-010	Electromotive	DM-15	1
C29	Capacitor, .1 μF	900001-013	Amperex	C280AE	1
C30	Capacitor, .01 μF	900001-001	Amperex	C280AE	1
C31	Capacitor, 2 pF	900003-002	Electromotive	DM-15	1
C32	Capacitor, 82 pF	900003-028	Electromotive	DM-15	1

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
C33	Capacitor, 470 pF	900003-047	Electromotive	DM-15	1
C34	Not used				0
C35	Capacitor, 56 pF	900003-024	Electromotive	DM-15	1
C36	Capacitor, Variable 1.7-11 pF	900113-002	JFD	DVJ-302A	1
C37	Not used				0
C38	Capacitor, .022 μF	900001-005	Amperex	C280AE	1
C39	Capacitor, .01 μF	900001-001	Amperex	C280AE	1
C40	Capacitor, 470 pF	900003-047	Electromotive	DM-15	1
C41, C43	Not used				0
C44	Capacitor, 1000 pF	900003-056	Electromotive	DM-15	1
C45, C46	Not used				0
C47	Capacitor, 27 pF	900003-015	Electromotive	DM-15	1
C48	Not used				0
C49	Capacitor, .1 μF	900001-013	Amperex	C280AE	1
L1	Coil	906006-003	Artted		1
L2	Choke, 10 μH	906022-005	J.W. Miller	70F105A1	1
L3-L5	Coil	906006-009	Artted		3
L6	Coil, 1/4" LD, 4-1/2T	402965-002	Singer		1
L7	Coil, 1/4" ID, 4-1/2T	402965-002	Singer		1
Q1, Q2	Transistor	958000-001	Motorola	2N3904	2
Q3	Transistor	958000-002	Motorola	2N3906	1
Q4	Transistor	958018-001	Motorola	2N5179	1
Q5	Transistor	958000-002	Motorola	2N3906	1
Q6, Q7	Transistor	958018-001	Motorola	2N5179	2
Q8	Transistor	958000-001	Motorola	2N3904	1
Q9	Not used				0
Q10	Transistor	958018-001	Motorola	2N5179	1
R1	Resistor, 1k	945000-037	Allen-Bradley	Type CB	1
R2	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R3	Resistor, 1k	945000-037	Allen-Bradley	Type CB	1
R4	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R5	Resistor, 10k	945000-049	Allen-Bradley	Type CB	1
R6	Resistor, 150 ohm	945000-027	Allen-Bradley	Type CB	1

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
R7	Resistor, 56k	945000-058	Allen-Bradley	Type CB	1
R8	Resistor, 1.5k	945000-039	Allen-Bradley	Type CB	1
R9	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R10	Resistor, 10k	945000-049	Allen-Bradley	Type CB	1
R11	Resistor, 47k	945000-057	Allen-Bradley	Type CB	1
R12	Resistor, 470 ohm	945000-033	Allen-Bradley	Type CB	1
R13	Resistor, 150k	945000-063	Allen-Bradley	Type CB	1
R14, R15	Resistor, 220 ohm	945000-029	Allen-Bradley	Type CB	2
R16	Resistor, 150 ohm	945000-027	Allen-Bradley	Type CB	1
R17	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R18	Resistor, 1.5k	945000-039	Allen-Bradley	Type CB	1
R19	Resistor, 1.2k	945000-038	Allen-Bradley	Type CB	1
R20	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R21	Resistor, 15k	945000-051	Allen-Bradley	Type CB	1
R22, R23	Resistor, 1k	945000-037	Allen-Bradley	Type CB	2
R24, R25	Resistor, 15k	945000-051	Allen-Bradley	Type CB	2
R26	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R27	Resistor, 3.9k	945000-044	Allen-Bradley	Type CB	1
R28	Resistor, Selected, 330 ohm Nominal	945000-031	Allen-Bradley	Type CB	1
R29	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R30	Resistor, 10 ohm	945000-013	Allen-Bradley	Type CB	1
R31	Resistor, 3.9k	945000-044	Allen-Bradley	Type CB	1
R32	Resistor, 220 ohm	945000-029	Allen-Bradley	Type CB	1
R33	Resistor, 15 ohm	945000-015	Allen-Bradley	Type CB	1
R34	Resistor, 10k	945000-049	Allen-Bradley	Type CB	1
R35	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	1
R36-R38	Not used				0
R39, R40	Resistor, 100 ohm	945000-025	Allen-Bradley	Type CB	2
R41-R45	Not used				0
R46	Resistor, 1.2k	945000-038	Allen-Bradley	Type CB	1
R47, R48	Not used				0
R49, R50	Resistor, 680 ohm	945000-035	Allen-Bradley	Type CB	2
R51	Resistor, 56 ohm	945000-022	Allen-Bradley	Type CB	1
U1	Integrated Cirucit	926018-001	Signetics Corp.	LU380A	1
Y1, Y2	Xtl, Freq., 3.6 MHz	912001-001	Singer		2

ACCESSORIES

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
	Adapter, BNC to UHF	910117-001		–	1
	Antenna	003408-001		EM-24	1
	Attenuator, Pad, RFA-20	001355-001	Singer	–	2
	Cable, BNC to BNC (RG-58 C/U) (3 ft.)	003159-001	–	–	1
	Power Cord, AC (7.5 ft.)	002978-001	–	–	1
	Power Cord, DC (12 ft.)	002979-001	–	–	1
	Manual	500783-238	Singer	–	1

SECTION VII

OAM-1 INSTALLATION

7.1 INSTALLATION PROCEDURE

To install the OAM-1 in the Mainframe:

a. Remove blank plate covering plug-in aperture by turning the two screws one-quarter turn CCW.

b. Remove protective cover on connector at rear of aperture.

c. Insert the OAM-1 unit flush with front panel.

> **CAUTION**
>
> Early FM-10 Mainframes have unventilated cases and will overheat when used with the OAM-1 plug-in. A vented replacement case is supplied with the OAM-1 to owners of unvented Mainframes. Ensure that case is vented before installing OAM-1.

d. Turn locking pawl CW until the OAM-1 plug-in is firmly locked.

SECTION VIII

OAM-1 THEORY OF OPERATION

8.1 INTRODUCTION

This section consists of the circuit description of the OAM-1 plug-in module. The information is presented to assist the user in the troubleshooting and maintenance of the unit. Refer to the detailed block diagram, Figure 8-1, and the schematic diagram, Figure 10-1.

8.2 THEORY OF OPERATION

8.2.1 GENERAL. The OAM-1 plug-in module derives its operating power and signal input from the mainframe via the rear connector, P1. It contains its own power switch to permit use of the mainframe while the plug-in is switched off. High voltages for the CRT are developed within the module by a dc-to-dc inverter operating from the +9 volts dc supplied by the mainframe. There are four subassemblies in the OAM-1: AM detector board, A1; high voltage power supply board, A2; vertical amplifier board, A3; and horizontal amplifier board, A4. The circuitry contained in the OAM-1 may be divided into four major sections: vertical deflection circuitry, horizontal deflection circuitry, internal modulator circuitry and power supply circuitry.

8.2.2 VERTICAL DEFLECTION CIRCUITRY. The 2 MHz IF signal from the mainframe is applied to a 2 MHz active filter, Q601/L601/L602/L603 via pin 16 of connector P1. This is followed by a 2 MHz tuned differential amplifier, U602/L606, and a buffer amplifier, Q603. The gain of the differential amplifier is controlled by CARRIER LEVEL potentiometer, R1.

The output of buffer amplifier, Q603, is applied to operational amplifier, Q604/Q605, peak detector, Q606, and buffer amplifier, Q607. The operational amplifier, Q604/Q605, has 100% feedback so that the loop gain is unity. The RC time constant of C628/R630 is sufficiently

short that the modulation envelope is accurately followed. An AGC loop from the output of buffer amplifier, Q607, to differential amplifier, U602, provides output stability with fluctuations of 6 to 10 dB in IF input signal level.

The output of buffer amplifier, Q607, is impressed across precision voltage divider, R656/R658/R659 and is also applied to recovered audio amplifier, Q608, when the VERT MODE switch, S2, is in any position except the EXT position. The output of recovered audio amplifier, Q608, is applied through buffer amplifier, Q609, to the mainframe via pin 14 of connector P1 and to distortion analyzer output amplifier, Q105. This output is connected to DIST ANAL jack, J2.

The output of buffer amplifier, Q607, is also applied to buffer amplifier, Q101, whenever VERT MODE switch, S2, is in either the MEAS AM or the CARR SET position. (In the CARR SET position, Capacitor C3 removes the ac component of the modulated signal.) Q102 is a constant current source for buffer amplifier, Q101, and the output of the buffer amplifier is applied to the high gain, dc-coupled vertical amplifier consisting of U101A/B, Q103 and Q104. (U101C is a constant current source for U101A/B). The vertical amplifier drives the CRT vertical deflection plates and VERT POS control, R6, sets the bias of U101B. When VERT MODE switch, S2, is in the EXT position, an external signal may be applied to VERT IN connector J1 for general oscilloscope use. VERT GAIN control, R3, provides attenuation of this external signal.

8.2.3 HORIZONTAL DEFLECTION CIRCUITRY. The sweep generator contains a current source, Q200, and a regenerative trigger, Q201/Q202, Sweep speed is controlled by SWEEP RANGE switch, S4, and SWEEP SPEED control, R5. The output level is controlled by variable resistor, R204. Synchronization is provided by the vertical signal output of Q104. The sweep generator output is applied to buffer amplifier, Q203, when MOD MODE switch, S6, is in either the INT or EXT position. The output of buffer amplifier, Q203, is applied to the dc-coupled horizontal deflection amplifier, Q204/Q205, having differential outputs which drive the horizontal deflection plates of the CRT. HORIZ POS control,

R8, sets the bias of Q205. The horizontal amplifier may be driven from an external source connected to the EXT MOD/HORIZ IN receptacle, J4, when the MOD MODE switch, S6, is in the EXT HORIZ position. The mainframe may be modulated from the EXT MOD/HORIZ IN receptacle, J4, when the MOD MODE switch, S6, is in the EXT position and the RANGE switch, S3, is in the GEN 30% position via the amplitude modulation amplifier, Q616/Q617, through pin 11 of connector P1.

8.2.4 INTERNAL MODULATOR CIRCUITRY. The 400 Hz/1 kHz Wein-bridge oscillator, Q610/Q611, is buffered by Q613 and automatically leveled by level detector, CR602/CR603 and ALC control, Q611. The oscillator frequency is selected by MOD/AUDIO OUT FREQ switch, S5, which selects feedback variable resistors R674 and R675 and frequency variable resistors R671 and R673 corresponding to the frequency selected. The output of the oscillator is impressed across INT MOD/AUDIO OUT control, R2, and the wiper of R2 is connected to 400 Hz/1 kHz driver amplifier, Q614. The output of Q614 is applied to AUDIO OUT connector, J3, via buffer amplifier, Q615. When the MOD MODE switch, S6, is in the INT position, the output from the Wein-bridge oscillator is first amplified by the 400 Hz/1 kHz driver and buffer, Q614/Q615, and then by AM modulation amplifier, Q616/Q617, and applied to the mainframe through pin 11 of connector, P1, when the RANGE switch, S3, is in the GEN 30% position.

8.2.5 POWER SUPPLY CIRCUITRY. The power supply is a dc-to-dc inverter that converts +9 volts from the mainframe when the PWR switch, S1, is on, to -1000 volts and +300 volts required by the CRT. The inverter also supplies -15 volts required by the vertical and horizontal deflection amplifiers and the AM detector board. 6.2V rms required by the CRT heater is also supplied. The inverter consists of a 40 kHz oscillator, Q1/Q2, a power transformer, T401, and three rectifiers, CR401/CR402, CR403/CR404, and CR405/CR406. The astigmatism control, R217, utilizes the +300V dc while the FOCUS and INTENSITY controls, R11 and R13 respectively, require the -1000V dc.

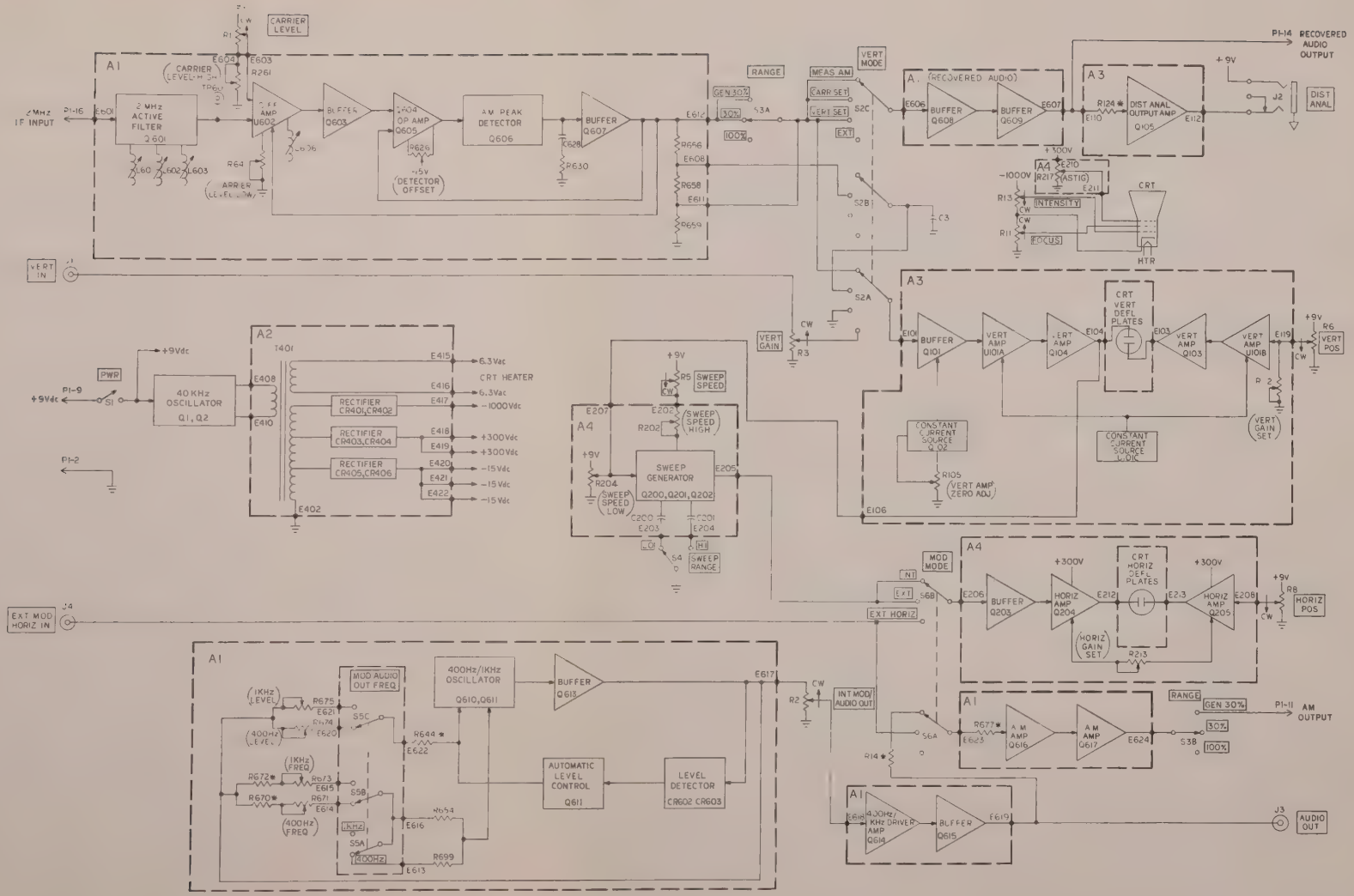


Figure 8-1. Detailed Block Diagram, Model OAM-1

SECTION IX

OAM-1 MAINTENANCE

9.1 INTRODUCTION

This section contains general maintenance, troubleshooting, and alignment information.

> NOTE: Throughout this section, the term 'CRT' denotes the oscilloscope CRT presentation on the OAM-1 module. The word 'Oscilloscope' is used when referring to a test oscilloscope (Tektronix Model 651B or equivalent).

9.2 GENERAL MAINTENANCE INFORMATION

9.2.1 BASIC REQUIREMENTS. Each OAM-1 module is carefully checked following alignment and calibration at the factory, and no further internal adjustments are required prior to placing the equipment in operation. In the event of failure or malfunction, troubleshooting or adjustments should be attempted only if proper test equipment is available, and only by qualified technicians.

9.2.2 TEST EQUIPMENT. The test equipment required for checkout, alignment, calibration, and troubleshooting is tabulated in Table 9-1. Use the recommended type or equivalent.

9.3 MINIMUM PERFORMANCE CHECKOUT PROCEDURE

9.3.1 REMOVAL FROM CASE. The OAM-1 is secured to the case by five screws in the back panel. Remove the screws and slide the cover off the back.

9.3.2 POWER REQUIREMENTS. All power required by the OAM-1 is supplied by the Mainframe.

> WARNING
> High voltages are present throughout the unit and appropriate precautions should be taken while operating the unit with cover removed.

TABLE 9-1. TEST EQUIPMENT REQUIREMENTS

TYPE	MINIMUM PARAMETERS	RECOMMENDED MODEL
Audio Oscillator	Frequency range: 45 Hz to 30 kHz Output: adjustable from 100 mV rms to 3 V rms	Hewlett-Packard, Model 200CD
AC VTVM	Frequency response: 50 Hz to 2 MHz Range: measure in the area of 100 mV rms	Hewlett-Packard, Model 400D
Signal Generator	Frequency range: 25 MHz to 150 MHz Stability: better than ±0.0004%/5 min Output: adjustable from <6 mV rms to >20 mV rms Leveling: ±1dB Output Impedance: 50 Ω nominal	Singer Model FM-2748
Oscilloscope	Frequency response: 10 MHz	Tektronic, Model 651B
Distortion Analyzer	Measure distortion <1% at 1 kHz and 400 Hz with 1 V rms into 600 ohms input	Hewlett-Packard, Model 331A
Frequency Counter	Frequency measurement: 1 kHz at 1 V rms input	Hewlett-Packard, Model 5532A
Frequency Meter	OAM-1 must be tested in an FM-10 series Mainframe	Singer, Model FM-10 or FM-10C
VOM	Range: 0 to 1100 V dc, positive and negative	Simpson, Model 269
DC Digital Voltmeter or VTVM	Range: 10 mV to 15 V dc Accuracy: ±3% of reading	Hewlett-Packard, Model 427A
Extender Cable	NA	Singer, Model PC-2653

9.3.3 FOCUS AND INTENSITY.

a. Turn POWER switch to ON.

b. Rotate INTENSITY control fully CW.

c. Rotate FOCUS control to mid-range.

d. Set VERT MODE switch at VERT SET.

e. Set MOD MODE switch at INT.

f. Allow 5 to 10 seconds for the CRT filaments to warm up. Adjust VERT POS and HORIZ POS controls until CRT trace is centered.

g. Readjust FOCUS and INTENSITY controls for sharpest trace with adequate intensity.

h. Verify that CRT trace is bright enough to see in a normally lit room. Verify that FOCUS, VERT POS, and HORIZ POS controls are approximately at mid-range.

9.3.4 VERTICAL AND HORIZONTAL POSITION CONTROL RANGE.

a. Rotate VERT POS control from fully CW to fully CCW.

b. Verify that CRT trace deflects off the calibrated portion vertically when VERT POS control is at its extremes.

c. Return VERT POS control to mid-range.

d. Rotate HORIZ POS control from fully CW to fully CCW.

e. Verify that ends of trace deflect horizontally to at least mid-screen when HORIZ POS control is at its extremes.

f. Return HORIZ POS control to mid-range.

g. Verify that trace is centered on CRT with controls set at approximately mid-range.

9.3.5 SWEEP RANGE.

a. Rotate VERT GAIN control fully CW.

b. Set VERT MODE switch at EXT.

c. Connect Audio Oscillator and AC VTVM to VERT IN jack.

d. Adjust Audio Oscillator frequency to 50 Hz and set AC VTVM to 300 mV scale.

e. Rotate SWEEP SPEED control fully CCW.

f. Set SWEEP RANGE switch at LO.

g. Increase Audio Oscillator output until sine wave on CRT is full scale. Adjust Audio Oscillator frequency for a stationary, one-cycle sine wave on CRT.

h. Verify that Audio Oscillator frequency is less than 50 Hz — approximately 45 Hz.

j. Rotate SWEEP SPEED control fully CW.

k. Set SWEEP RANGE switch at HI.

l. Adjust Audio Oscillator frequency for a stationary, one-cycle sine wave on CRT.

m. Verify that Audio Oscillator frequency is greater than 5000 Hz and is spread out across entire CRT.

n. Rotate SWEEP SPEED control fully CCW.

p. Adjust Audio Oscillator frequency for a stationary, one-cycle sine wave on CRT.

q. Verify that Audio Oscillator frequency is less than 500 Hz — approximately 450 Hz.

r. Set SWEEP RANGE switch at LO.

s. Rotate SWEEP SPEED control to fully CW.

t. Adjust Audio Oscillator frequency for a stationary, one-cycle sine wave.

u. Verify that Audio Oscillator frequency is more than 500 Hz — approximately 550 Hz.

9.3.6 VERTICAL SENSITIVITY.

a. Adjust Audio Oscillator frequency to 1 kHz.

b. Adjust SWEEP RANGE switch and SWEEP SPEED control for a stationary pattern on CRT.

c. Adjust output of Audio Oscillator for full scale deflection on CRT.

d. Verify that output of Audio Oscillator is between 95 and 117 mV rms.

9.3.7 VERTICAL AMPLIFIER FREQUENCY RESPONSE.

a. Adjust Audio Oscillator output to obtain exact full scale deflection on CRT at 1 kHz frequency.

b. Increase Audio Oscillator frequency to 30 kHz and note p-p deflection on CRT.

c. Decrease Audio Oscillator frequency to 50 Hz and note p-p deflection on CRT.

d. Verify that signal on CRT did not change more than 3 db or less than 7 divisions p-p from 50 Hz to 30 kHz.

9.3.8 CARRIER LEVEL CONTROL.

a. Connect Signal Generator to Mainframe MEASURE INPUT jack.

b. Set Signal Generator frequency at 25 MHz and output at 10 mV (CW).

c. FM-10 Mainframe, set frequency switches at 27 MHz and 10 MHz and AUDIO switches at OUT.

FM-10C Mainframe, set frequency switches at 25 MHz and MODE switch at MEAS.

d. Set VERT MODE switch at VERT SET.

e. Adjust VERT POS control so that CRT trace is exactly on VERTICAL SET line of the graticule.

f. Set VERT MODE switch at CARR SET.

g. Adjust Signal Generator frequency vernier for maximum upward deflection of trace on CRT.

h. Adjust CARR LEVEL control so that CRT trace is exactly on CARRIER SET line of the graticule.

j. Decrease Signal Generator output 3 db from 10 mV (7.07mV).

k. Increase CARRIER LEVEL control until CRT trace is exactly on CARRIER SET line.

l. Verify that CARRIER LEVEL control has sufficient range to put CRT trace on CARRIER SET line of the graticule ±½ division.

m. Increase Signal Generator output 6 db (14.1mV).

n. Decrease CARRIER LEVEL control until CRT trace is exactly on CARRIER SET line.

p. Verify that CARRIER LEVEL control has sufficient range to put CRT trace on CARRIER SET line of the graticule ±½ division.

q. Readjust Signal Generator output to 10 mV and frequency for maximum upward deflection of CRT trace.

r. Recalibrate for VERT SET and CARR SET (step d through h).

s. Set VERT MODE switch at MEAS AM.

t. Verify that CRT trace is on the 0 center line of graticule. (There may be a slight amount of noise appearing on the trace, but this is normal.)

9.3.9 MODULATION MEASUREMENT ACCURACY.

a. Recalibrate as specified in paragraph 9.3.8, steps d through h, if necessary.

b. Set Signal Generator modulation mode switch at external position.

c. Connect Audio Oscillator to external modulation jack of Signal Generator and also external horizontal jack of Oscilloscope.

d. Set Audio Oscillator frequency at 1 kHz and output level at approximately 8 V p-p.

e. Set RANGE switch at 30%.

f. Adjust modulation amplitude control on Signal Generator to obtain full scale deflection (30%) on CRT.

g. Remove Signal Generator cable from the Mainframe MEASURE INPUT jack and connect it to vertical input jack on Oscilloscope.

h. On Oscilloscope, set horizontal display switch at external horizontal attenuator X1, adjust external horizontal attenuator control for approximately 5 cm horizontal deflection, set time/centimeters switch at 2 seconds, and adjust vertical sensitivity to obtain exactly 4 cm vertical deflection for E max on trapezoid pattern.

j. Verify that E min on trapezoid pattern on Oscilloscope is between 2.3 and 2.0 cm (27% to 33% modulation).

k. Remove Signal Generator cable from vertical input jack on Oscilloscope and reconnect it to FM-10 or FM-10C MEASURE INPUT jack.

l. Set RANGE switch at 100%.

m. Adjust Signal Generator modulation amplitude control to obtain 8 divisions (80% modulation) deflection on the graticule.

n. Verify that sine wave pattern on CRT is symmetrical about the 0 center line of graticule and is free of clipping on the peaks.

p. Reconnect Signal Generator cable to the vertical input jack on Oscilloscope.

q. Readjust vertical sensitivity to obtain 4 cm vertical deflection for E max on trapezoid pattern.

r. Verify that E min on trapezoid pattern on Oscilloscope is between 0.70 and 0.21 cm (70 to 90% modulation).

9.3.10 MAINFRAME (INTERNAL) MODULATION CAPABILITY AND RECOVERED AUDIO DISTORTION.

a. On FM-10 Mainframe, press 10 MHz switch to IN; set frequency switches at 12 MHz.

On FM-10C Mainframe, set MODE switch at GEN MOD CAL.

b. Press GENERATOR MODULATION switch to IN/ON.

c. Set VERT MODE switch at VERT SET.

d. Position CRT trace on VERTICAL SET line of the graticule with VERT POS control.

e. Set VERT MODE switch at CARR SET. Position CRT trace on CARRIER SET line of the graticule with CARRIER LEVEL control.

f. Set RANGE switch at GEN 30%.

g. Set MOD/AUDIO OUT FREQ switch at either 1 kHz or 400 Hz.

h. Rotate INT MOD/AUDIO OUT control to fully CW.

j. Set VERT MODE switch at MEAS AM.

k. Verify that recovered audio on CRT is greater than full scale deflection.

l. Rotate INT MOD/AUDIO OUT control for exact full scale deflection.

m. Connect Distortion Analyzer to DIST ANAL jack and calibrate it to modulating frequency.

n. Verify that measured distortion is less than 3% at 30% modulation.

9.3.11 EXTERNAL MODULATION CAPABILITY, FREQUENCY RESPONSE, AND RECOVERED AUDIO DISTORTION.

a. Connect Audio Oscillator and AC VTVM to EXT MOD/HORIZ IN jack.

b. Set Audio Oscillator frequency to 1 kHz and its output to approximately 500 mV rms.

c. Set MOD MODE switch at EXT.

d. Recalibrate VERT SET and CARR SET and set VERT MODE switch at MEAS AM.

e. Readjust Audio Oscillator output to obtain full scale deflection (30% modulation) on CRT.

f. Note VTVM reading.

g. Verify that external signal level required to produce 30% modulation is 500 mV rms ±20%.

h. Calibrate Distortion Analyzer at 1 kHz.

j. Verify that measured distortion is less than 3% at 30% modulation.

k. Vary Audio Oscillator frequency between 50 Hz and 3 kHz. Verify that recovered audio level on CRT does not change more than 3 db over the frequency range of 50 Hz to 3 kHz.

9.3.12 EXTERNAL HORIZONTAL SWEEP CAPABILITY.

a. Set MOD MODE switch at EXT HORIZ.

b. Set Audio Oscillator frequency at 1 kHz, apply output to EXT MOD/HORIZ IN jack, and adjust output until trace is spread over the diameter of CRT.

c. Verify that amplitude required for full diameter deflection is no greater than 600 mV rms.

9.3.13 AUDIO OUTPUT FREQUENCY, LEVEL, AND DISTORTION.

a. Connect AC VTVM and Frequency Counter to AUDIO OUT 600Ω jack.

b. Connect a 600Ω resistive load across the AC VTVM terminals.

c. Set MOD/AUDIO OUT FREQ switch at 1 kHz.

d. Rotate INT MOD/AUDIO OUT control fully CW.

e. Note readings on AC VTVM and Frequency Counter.

f. Verify that frequency is 1 kHz ±5%; the level should be 1 V rms minimum into 600Ω.

g. Disconnect Frequency Counter from AUDIO OUT 600Ω jack and connect Distortion Analyzer. Set audio out control for 1 V rms output into 600 ohm load.

h. Calibrate Distortion Analyzer at 1 kHz and note the reading. Distortion should be less than 1%.

j. Disconnect Distortion Analyzer and reconnect Frequency Counter to AUDIO OUT 600Ω jack.

k. Set MOD/AUDIO OUT FREQ switch at 400 Hz.

l. Note readings on AC VTVM and Frequency Counter.

m. Verify that frequency is 400 Hz ±5%; the level should be 1 V rms minimum into 600Ω .

n. Disconnect Frequency Counter and Connect Distortion Analyzer.

p. Calibrate Distortion Analyzer at 400 Hz and note the reading. Distortion should be less than 1%.

9.4 ALIGNMENT AND ADJUSTMENT

> WARNING
>
> High voltages are present throughout the unit and appropriate precautions should be taken while operating the unit with cover removed.

9.4.1 HORIZONTAL AMPLIFIER BOARD ASSEMBLY A4 (FIGURE 9-1).

9.4.1.1 Location and Adjustment of the Scope Trace.

a. With power applied to the OAM, set VERT MODE switch S2 at VERT SET. Turn INTENSITY control fully CW.

b. Rotate HORIZ POS R8 and VERT POS R6 controls to mid-range. Set MOD MODE switch S6 at INT.

c. The CRT trace should now be present. If not, vary the VERT POS and HORIZ POS controls until CRT trace is obtained.

d. Center CRT trace. Adjust INTENSITY and FOCUS controls to sharpen trace.

e. Adjust astigmatism control A4-R217 for maximum sharpness of CRT trace.

f. Adjust gain set control A4-R213 to increase or decrease width of CRT trace.

9.4.1.2 Sweep Range Adjustment.

a. Rotate VERT GAIN control R3 fully CW. Set VERT MODE switch at EXT.

b. Connect Audio Oscillator to VERT IN jack J1. Set Audio Oscillator frequency at 45 Hz.

c. Increase Audio Oscillator gain control until sine wave observed on the scope is full scale.

d. Turn SWEEP SPEED control R5 fully CCW. Set SWEEP RANGE switch at LO.

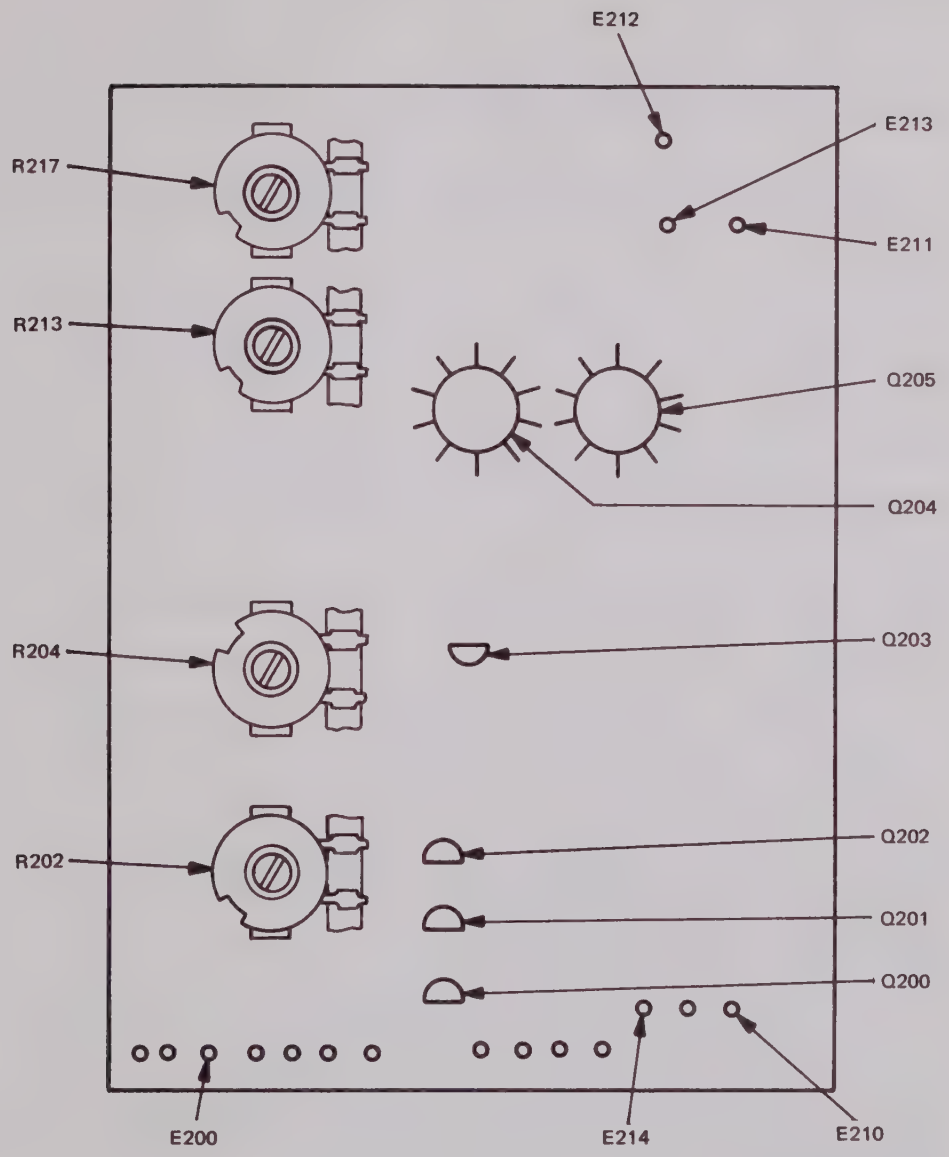


Figure 9-1. Horizontal Amplifier Board Assembly A4

e. Adjust A4-R204 to obtain a stationary, one-cycle pattern on CRT.

NOTE: After adjusting R204, it may be necessary to slightly readjust A4-R213 to widen trace to the width of the CRT.

f. Turn SWEEP SPEED control fully CW. Set SWEEP RANGE switch at HI. Increase Audio Oscillator frequency to 5 kHz.

g. Adjust A4-R202 to obtain a stationary, one-cycle pattern on CRT.

h. Repeat steps b through g until no further adjustment is needed.

j. With SWEEP RANGE switch at HI, rotate SWEEP SPEED control fully CCW.

k. Adjust Audio Oscillator for a stationary one-cycle pattern. The frequency required for this condition should be less than 500 Hz - approximately 450 Hz.

l. Set SWEEP RANGE switch at LO. Rotate SWEEP SPEED control fully CW.

m. Adjust Audio Oscillator frequency for a stationary one-cycle pattern. The frequency required for this condition should be more than 500 Hz - approximately 550 Hz.

9.4.2 VERTICAL AMPLIFIER BOARD ASSEMBLY A3 (FIGURE 9-2).

9.4.2.1 Vertical Positioning Adjustment.

a. Set VERT MODE switch S2 at VERT SET.

b. Rotate VERT POS control R6 to mid-range.

c. Adjust A3-R105 to position trace on the center line of CRT graticule.

9.4.2.2 Amplitude Adjustment.

a. Connect Audio Oscillator to AC VTVM and to VERT IN jack J1. Set frequency for 1 kHz and amplitude for 0.3 volts p-p.

b. Set VERT MODE switch at EXT. Rotate VERT GAIN control fully CW.

c. Adjust gain set control A3-R112 for full scale deflection on CRT. Simultaneously, adjust A3-R105 to maintain a centered display.

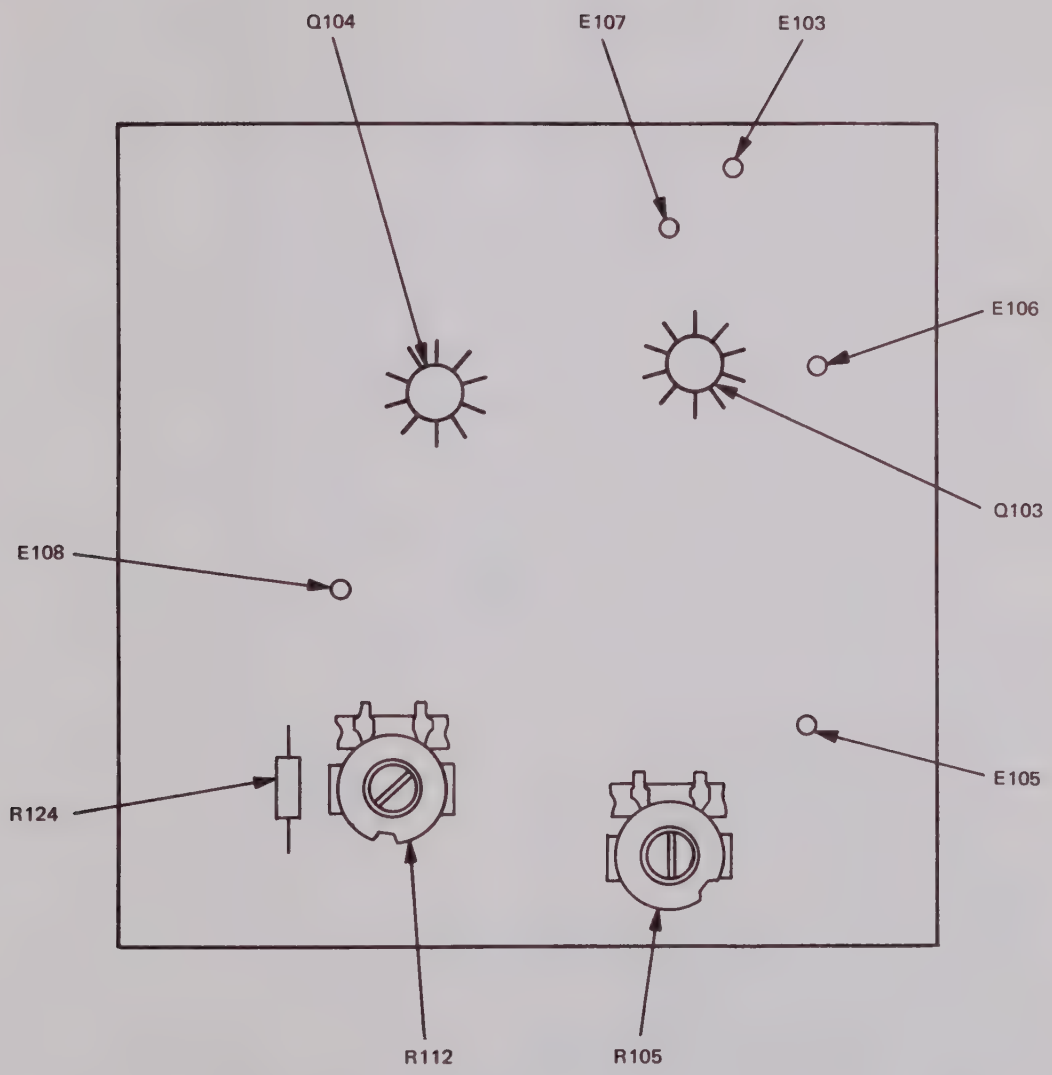


Figure 9-2. Vertical Amplifier Board Assembly A3

9.4.3 AM DETECTOR BOARD ASSEMBLY A1 (FIGURE 9-3).

9.4.3.1 IF Amplifier Tuning.

a. Connect Oscilloscope probe to U602-2 on IF Board.

b. On FM-10 Mainframe, push 10 MHz button in, set frequency controls at 011.975 MHz, and set 0-1 KHz dial at OUT.

On FM-10C Mainframe, set MODE switch at MEAS, set frequency controls at 009.9750, and set 0-100 Hz frequency control at OUT. Apply 10 MHz time base output from ACC connector on rear panel to MEASURE INPUT through an RFA-20 attenuator.

c. Adjust L-603 for maximum amplitude on Oscilloscope.

d. On FM-10 Mainframe, set frequency controls at 012.025 MHz.

On FM-10C Mainframe, set frequency controls at 010.0250 MHz.

e. Adjust L-602 for maximum amplitude on Oscilloscope.

f. On FM-10 Mainframe, set frequency controls at 012.000 MHz.

On FM-10C Mainframe, set frequency controls at 010.0000 MHz.

g. Adjust L-601 for maximum amplitude on Oscilloscope.

h. Repeat steps b through g until no further peaking can be obtained.

j. Set A1-R641 trimpot at mid-range. Connect Oscilloscope probe across A1-R625 (1 kΩ).

k. Adjust A1-L606 for maximum deflection on Oscilloscope. Disconnect Oscilloscope probe.

9.4.3.2 Detector Offset Adjustment.

a. Connect an alligator clip between A1-E601 and ground.

b. On FM-10 Mainframe, release 10 MHz button.

On FM-10C Mainframe, set MODE switch at GEN.

c. Set VERT MODE switch S2 at VERT SET. Adjust VERT POS control R6 so CRT trace is exactly on the VERTICAL SET line.

d. Set VERT MODE switch at CARR SET. Adjust A1-R626 trimpot so that CRT trace is exactly on the VERTICAL SET line.

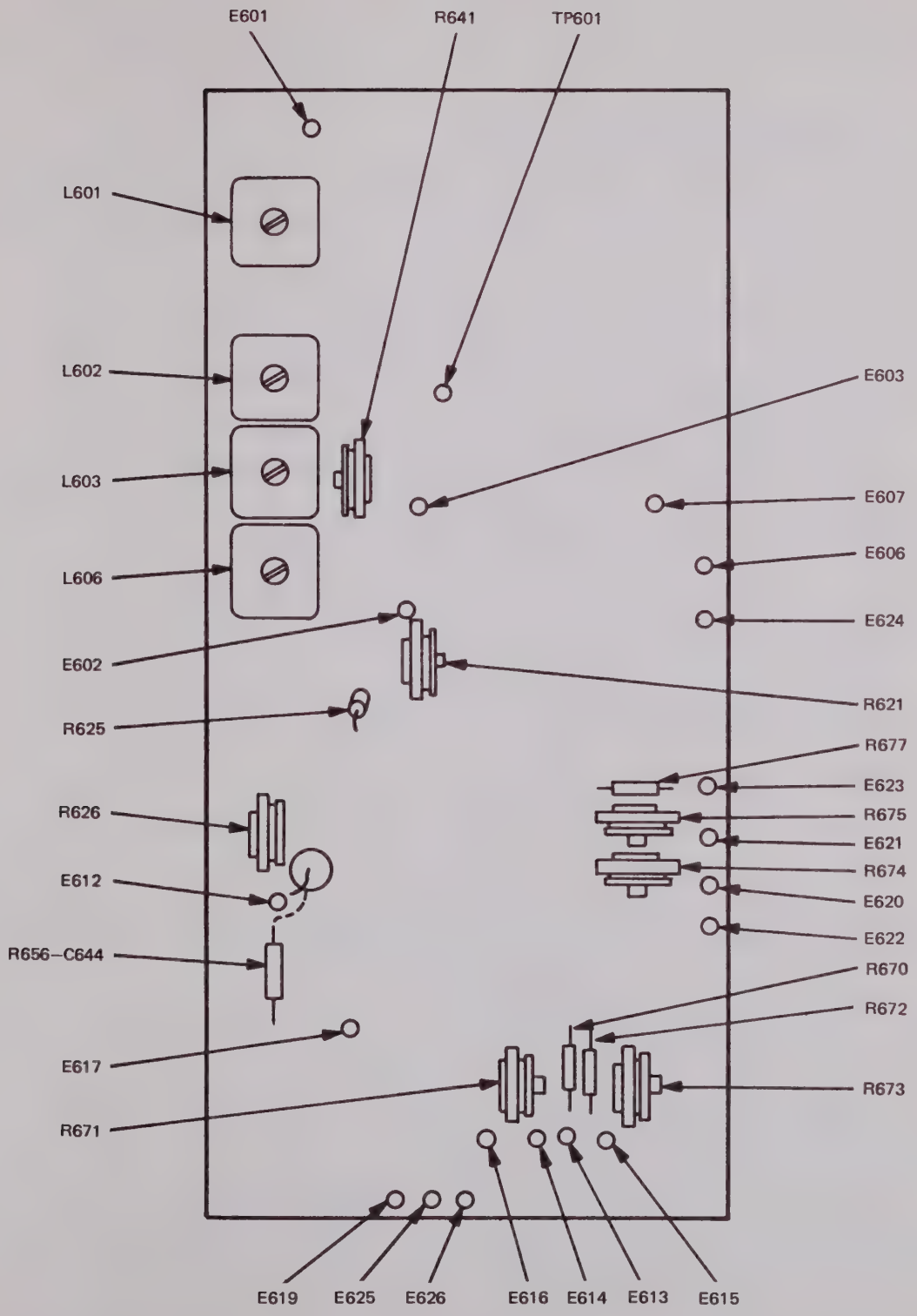


Figure 9-3. AM Detector Board Assembly A1

e. Repeat steps c and d.

f. Remove jumper lead installed in step a.

9.4.3.3 IF Dynamic Range Adjustment.

a. Connect Signal Generator to Mainframe MEASURE INPUT jack.

b. Set Signal Generator frequency at 61 MHz and output level to 6 mV (CW).

c. On FM-10 Mainframe, set frequency controls at 63 MHz.

On FM-10C Mainframe, set frequency controls at 61 MHz. Set MODE switch at MEAS.

d. On the OAM-1, set VERT MODE switch S2 at VERT SET. Adjust VERT POS control R6 so that CRT trace is exactly on VERTICAL SET line. Rotate CARRIER LEVEL control R1 fully CW.

e. Set VERT MODE switch at CARR SET. Adjust Signal Generator frequency vernier for maximum upward deflection of CRT trace.

f. Adjust A1-R641 trimpot so that CRT trace is exactly on CARRIER SET line of CRT graticule.

g. Repeat steps d, e, and f.

h. Rotate CARRIER LEVEL control fully CCW. Increase Signal Generator output level until CRT trace is exactly on CARRIER SET line. Signal Generator output level should be between 16 and 20 mV. If not, adjust Signal Generator to 18 mV and adjust R621 for CARRIER SET line.

j. Repeat steps d through h.

k. Adjust Signal Generator output level to 6 mV. Rotate CARRIER LEVEL control fully CW.

l. Set VERT MODE switch at MEAS AM. The CRT trace should be exactly on 0 center line of graticule. Noise on trace should have equal amplitude above and below 0 center line.

NOTE: If trace is offset from 0 center line, repeat steps of paragraphs 9.4.3.2 and 9.4.3.3.

9.4.3.4 Modulation Measurement Accuracy (at 10 MHz).

a. Set RANGE switch S3 at 30% and the frequency dials to 12.000 MHz.

b. Connect Audio Oscillator to both the Signal Generator external modulation input jack and to the Oscilloscope external horizontal input jack.

c. Set Audio Oscillator frequency at 1 kHz and output level to approximately 8V p-p.

d. Set Signal Generator frequency to 10 MHz and output level to 6 mV modulation selector switch at external position and adjust modulation level control so that CRT waveform is deflected exactly full scale (30% modulation).

e. Disconnect cable from Mainframe MEASURE INPUT jack and connect it to Oscilloscope vertical input jack.

f. Adjust vertical and external horizontal controls to obtain a trapezoid pattern whose width is approximately 5 cm and whose E max amplitude is exactly 4 cm. E min amplitude should be within 2.3 to 2.0 cm (27% to 33% modulation).

g. Disconnect cable from Oscilloscope vertical input jack and connect it to Mainframe MEASURE INPUT jack.

h. Set RANGE switch S3 at 100%.

j. Increase Signal Generator modulation level control so that CRT waveform is deflected exactly 80%.

k. Disconnect cable from the Mainframe MEASURE INPUT jack and connect it to Oscilloscope vertical input jack.

l. Adjust Oscilloscope controls so that E max amplitude is exactly 4 cm. E min amplitude should be within 0.70 to 0.21 cm (70% to 90% modulation).

m. Disconnect cable from Oscilloscope vertical input jack and connect it to Mainframe MEASURE INPUT jack.

n. Increase Signal Generator modulation level control so that CRT waveform is deflected 95%. Waveform should be symmetrical above and below the 0 center line and no clipping of the peak should be evident.

b. If voltages are within tolerance, replace V1.

c. If any voltage is absent or out of tolerance, check voltage source on board A2, A3, or A4 output terminals.

9.5.2 FOCUS DEFECTIVE (9.3.3-g).

a. Check voltage on pin 5 of V1. Voltage should vary over at least a 100-volt span within -650 V dc and -920 V dc as FOCUS control R11 is adjusted to extremes.

b. If voltage is within tolerance, change V1.

c. If voltage is not within tolerance, check for -1000 V dc at E417 on board A2.

d. If voltage is within tolerance at E417, check wiring and neon indicator DS-1.

e. If voltage at E417 is out of tolerance, use Figure 10-1 voltages and waveforms to isolate fault on board A2.

9.5.3 INTENSITY DEFECTIVE (9.3.3-g).

NOTE: The OAM-1 operates in Mainframes designed for 12-V dc operation. The normal maximum intensity is not as high as that of oscilloscopes designed for 115-V ac operation because a lower power CRT is used to conserve current drain in battery operation.

a. Check voltage on pin 3 of V1 and ensure that voltage varies over a 50-Volt span in the range of -850 V dc to -1100 V dc as INTENSITY control R13 is rotated to extremes.

b. If voltage is within tolerance, replace V1.

c. If voltage is out of tolerance, check voltage at E417 of A2.

d. If voltage is in tolerance at E417, check associated wiring and INTENSITY control R13.

e. If voltage at E417 is out of tolerance, use Figure 10-1 voltages and waveforms to isolate fault in board A2.

9.5.4 VERTICAL CENTERING DEFECTIVE (9.3.3-f).

a. Check voltages at pins 9 and 10 of V1. Voltage should be adjustable over an 80 V minimum span within the range of +95 V dc to +235 V dc as the VERT POS control is rotated to extremes.

b. If voltages are within tolerance, replace V1.

c. If voltages are not within tolerance, check voltage at E119 on board A3. This voltage should vary from less than +0.1 V dc to greater than 2.3 V dc as the VERT POS control is rotated to extremes.

d. If voltage at E119 is within tolerance, use voltages and waveforms on Figure 10-1 to isolate fault on board A3.

e. If voltage at E119 is not within tolerance; check R6, R7, and associated wiring.

9.5.5 HORIZONTAL CENTERING DEFECTIVE (9.3.3-f).

a. Check voltages at pins 6 and 7 of V1. Voltages should vary over a 240 V minimum span within the range of 0 V dc to +330 V dc as the HORIZ POS control is rotated to extremes.

b. If voltages are within tolerance, replace V1.

c. If voltages are not within tolerance, check voltage at E208 on board A4. This voltage should vary from 0 V dc to +4.8 V dc nominal as HORIZ POS control R8 is rotated to extremes.

d. If voltage at E208 is not within tolerance, check voltage at E209. Voltage should be 4.3 V dc to 5.3 V dc.

e. If voltage at E208 is within tolerance, use voltages and waveforms on Figure 10-1 to isolate fault on the board A4.

9.5.6 VERT POS CONTROL CANNOT ADJUST TRACE OFF SCREEN (9.3.4-b). Perform procedures of paragraph 9.5.4.

9.5.7 HORIZ POS CONTROL CANNOT ADJUST TRACE TO MID-SCREEN (9.3.4-c).

a. Perform procedures of paragraph 9.5.5.

b. Perform procedures of paragraph 9.5.21.

9.5.8 SWEEP SPEED CANNOT ADJUST BELOW 50 Hz ON LOW RANGE (9.3.5-h).

a. On board A4, check resistance of E203 to ground. If resistance is greater than 10 ohms, check wiring of SWEEP RANGE switch S4.

b. If E203 is grounded, check voltage at E203 to ensure that voltage varies over a span of at least 0.6 V dc within the range of +7.4 V dc to +9.9 V dc.

c. If voltage is within tolerance, use voltages and waveforms on Figure 10-1 to isolate fault on board A4.

9.5.9 SWEEP SPEED CANNOT ADJUST ABOVE 5000 Hz ON HIGH RANGE (9.3.5-m).

a. On board A4, check resistance of E203 to ground. If resistance is less than 100 kΩ, check wiring of SWEEP RANGE switch S4.

b. If resistance is greater than 100 kΩ, check voltage at E202 to ensure that voltage varies over a span of at least 0.6 V dc within the range of +7.4 V dc to +9.9 V dc.

9.5.10 SWEEP SPEED CANNOT ADJUST BELOW 500 Hz ON HIGH RANGE (9.3.5-q). Perform procedures of paragraph 9.5.9.

9.5.11 SWEEP SPEED CANNOT ADJUST ABOVE 500 Hz ON LOW RANGE (9.3.5-u). Perform procedure of paragraph 9.5.8.

9.5.12 EXTERNAL VERTICAL INPUT SENSITIVITY NOT WITHIN SPECIFICATION LIMITS (9.3.6-d).

a. Apply a 1-kHz signal of 106 mV rms to VERT IN connector and check voltage with a scope at E101. Voltage should be 300 mV p-p.

b. If voltage is not 300 mV p-p, check VERT GAIN control R3, R4, and associated wiring.

c. If voltage is 300 mV p-p, use voltages and waveforms on Figure 10-1 to isolate fault.

9.5.13 TRACE CANNOT ADJUST TO VERT SET LINE IN VERT SET MODE (9.3.8-e). Perform procedures of paragraph 9.5.4.

9.5.14 CARRIER LEVEL CONTROL CANNOT SET TRACE PROPERLY IN CARRIER SET MODE (9.3.8-h, 1, p).

a. Check signal level at E601 on board A1. If level is not 11 mV p-p ±10%, fault is in Mainframe; refer to Maintenance Section in Mainframe manual.

b. If signal level is correct, check dc voltage at E603. Voltage should vary over a span of at least 1 V within the range of 0 to +2.0 V dc as CARRIER LEVEL control R1 is rotated to extremes.

c. If voltage at E603 is not within tolerance, check R1 and associated wiring. Also, check voltages on E602 and E604 to verify that levels are within tolerances specified on Figure 10-1.

d. If voltage at E603 is within tolerance, check dc voltage at E101 on board A3. Voltage should be +.30 V dc ±10%.

e. If voltage at E101 is within tolerance, use Figure 10-1 voltages and waveforms to isolate fault on board A3.

f. If voltage is not within tolerance at E101, check voltage at E608.

g. If voltage at E608 differs from voltage at E101, check S2, S3, and associated wiring.

h. If voltage at E608 is the same as that at E101, use Figure 10-1 voltages and waveforms to locate fault on board A1.

9.5.15 TRACE NOT ON CRT CENTERLINE WHEN MEASURING UNMODULATED SIGNAL (9.3.8-t).

a. Measure dc voltage at E101 on board A3. Voltage should be between 0.13 and 0.17 V dc.

b. If voltage is within tolerance, use Figure 10-1 voltages and waveforms to isolate fault on board A3.

c. If voltage is not within tolerance, check voltage at E611 on board A1. If this voltage differs from voltage at E101, check S2, S3, and associated wiring.

d. If voltage at E611 is the same as voltage at E101 and not between +0.12 V dc and +0.17 V dc, use Figure 10-1 voltages and waveforms to isolate fault on board A1.

9.5.16 AM DOES NOT MEASURE WITHIN SPECIFIED ACCURACY (9.3.9-j, r).

a. Check waveform at E101 with Oscilloscope. Level should be between 270 and 330 mV p-p. If not, use Figure 10-1 voltages and waveforms to isolate fault on board A3.

b. If voltage at E101 is not within above tolerance, check signal at E611 on board A1. If level at E611 differs from signal at E101, check S2, S3, and associated wiring.

c. If signal at E611 is the same as signal at E101 and not between 270 and 330 mV p-p, use Figure 10-1 voltages and waveforms to isolate fault on board A1.

9.5.17 TRACE CANNOT SET ON CRT CARRIER SET LINE WITH MAINFRAME IN CALIBRATE MODE (9.3.10-e). If procedures of paragraph 9.3.8 can be accomplished and those of step 9.3.10-e cannot, the problem is in the Mainframe. Refer to Maintenance Section in Mainframe manual.

9.5.18 UNIT CANNOT MODULATE FULL SCALE ON CRT USING INTERNAL SOURCE (9.3.10-k).

a. Check signal level at P1-11 with Oscilloscope. Level should be greater than 300 mV p-p. If it is, fault is in Mainframe. Refer to Maintenance Section in Mainframe manual.

b. If level at P1-11 is less than 300 mV p-p, check level at E624 on board A1. If level at E624 differs from level at P1-11, check S3 and associated wiring.

c. If signal at E624 is the same as signal at P1-11 and over 300 mV p-p, check signal at E628. This signal should be

greater than 1.2 V p-p. If it is, fault is in buffer stages Q616 and Q617.

d. If level is less than 1.2 V p-p at E623, check level at E614. If level at E614 differs from level at E623; check AUDIO OUT control R2, S6, and associated wiring.

e. If level at E614 is the same as at E623 and less than 1.2 V p-p, use Figure 10-1 voltages and waveforms to isolate fault on board A1.

9.5.19 MODULATION DISTORTION EXCEEDS 3% AT 30% MODULATION (9.3.10-n).

a. Adjust INT MOD/AUDIO OUT control for 1 V rms out of AUDIO OUT jack into a 600-ohm load.

b. Connect Audio Distortion Analyzer input across 600-ohm load and measure distortion.

c. Distortion should be less than 1%. If it is, the fault is in the Mainframe. Refer to Maintenance Section of Mainframe manual.

d. If distortion is greater than 1% at AUDIO OUT 600-ohm jack, check distortion at E617. If distortion at E617 is less than 1%, fault is in stages Q614 and Q615.

e. If distortion at E617 exceeds 1%, use Figure 10-1 voltages and waveforms to isolate fault on board A1.

9.5.20. EXTERNAL MODULATION SENSITIVITY NOT WITHIN SPECIFICATION LIMITS (9.3.11-g).

a. Set external modulation input level at exactly 500 mV rms and measure level at E623.

b. If level at E623 is not 500 mV rms, check S6 and associated wiring.

c. If level at E623 is 500 mV rms, check level at E624. Level at E624 should be between 60 mV rms and 90 mV rms. If not, fault is in stages Q616 and Q617.

9.5.21 EXTERNAL HORIZONTAL INPUT SENSITIVITY NOT WITHIN SPECIFICATION LIMITS (9.3.12-c).

a. Set Audio Oscillator output level at exactly 600 mV rms and check level at E206 on board A4. If level is not equal to input level, check S6 and associated wiring.

b. If level at E206 is equal to input, use Figure 10-1 voltages and waveforms to isolate fault on board A4.

9.5.22 FREQUENCY OF INTERNAL 1-kHz TONE NOT WITHIN SPECIFICATION LIMITS (9.3.13-f). Use Figure 10-1 voltages and waveforms to isolate fault on board A1.

9.5.23 AUDIO OUTPUT LESS THAN 1 V RMS INTO 600Ω LOAD AT 1 kHz (9.3.13-f).

a. Check level at E618. Level should be greater than 1.2 V p-p. If it is, fault is in stages Q614 and Q615. Use Figure 10-1 voltages to further isolate fault.

b. If level at E618 is within tolerance, check level at E617. If level at E617 differs from level at E618; check R2, S6, and associated wiring.

c. If level at E617 is equal to level at E618 and is less than 1.2 V p-p, use Figure 10-1 voltages and waveforms to isolate fault on board A1.

9.5.24 AUDIO DISTORTION GREATER THAN 1% AT 1-kHz (9.3.13-h). Perform steps d and e of paragraph 9.5.19.

9.5.25 INTERNAL 400-Hz FREQUENCY NOT WITHIN SPECIFICATION LIMIT (9.3.13-m). Use Figure 10-1 voltage and waveforms to isolate fault on board A1.

9.5.26 AUDIO OUTPUT LESS THAN 1 V RMS INTO 600Ω LOAD AT 1 kHz. (9.3.13-n). Perform procedures of paragraph 9.5.23.

9.5.27 AUDIO DISTORTION GREATER THAN 1% AT 400 Hz (9.3.13-p). Perform steps d and e of paragraph 9.5.19.

9.5.28 POWER SUPPLY BOARD ASSEMBLY A2. Figure 9-4 is provided as an aid should fault isolation of power supply board assembly A2 become necessary.

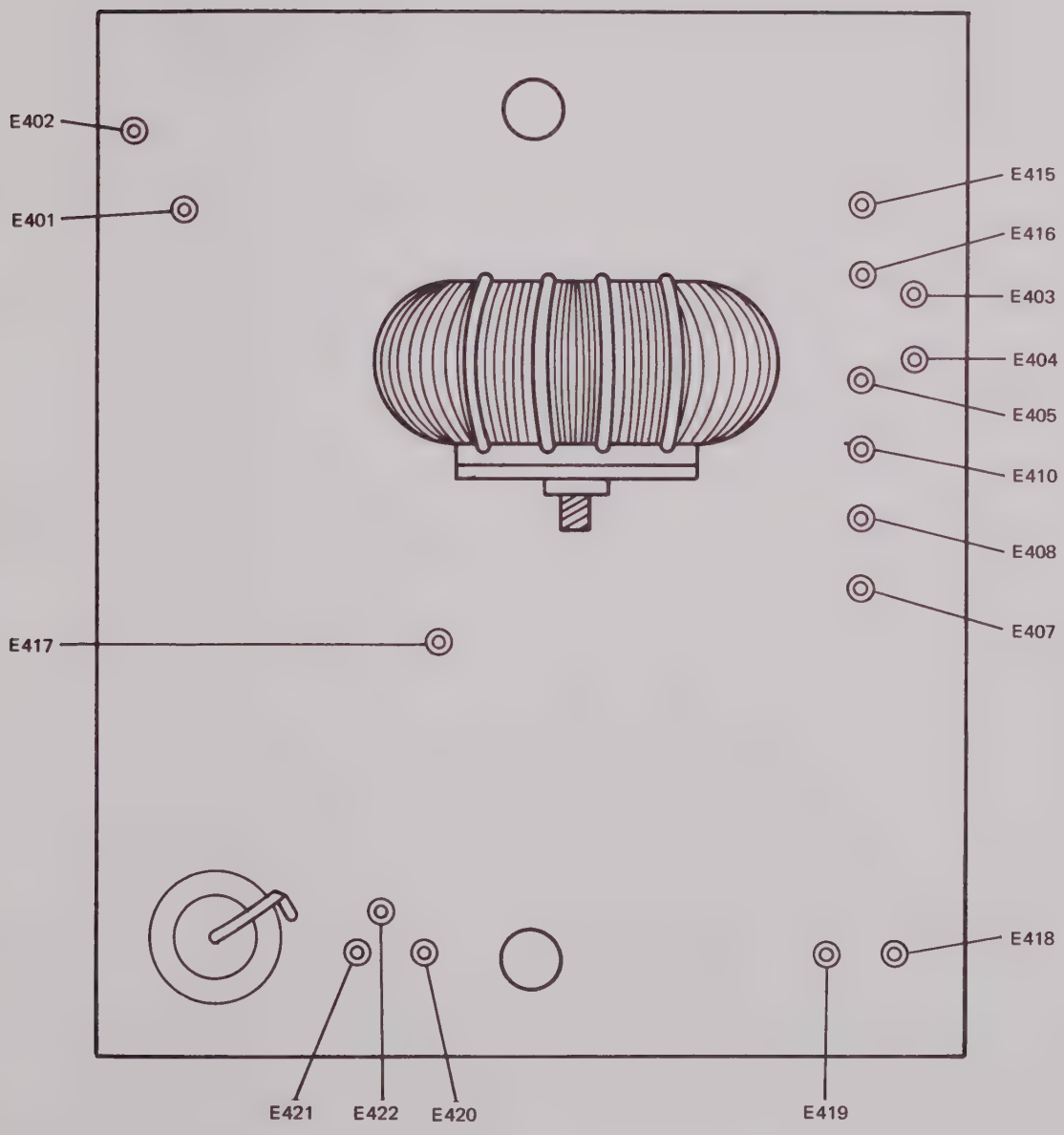


Figure 9-4. Power Supply Board Assembly A2

SECTION X

OAM-1 SCHEMATIC DIAGRAM

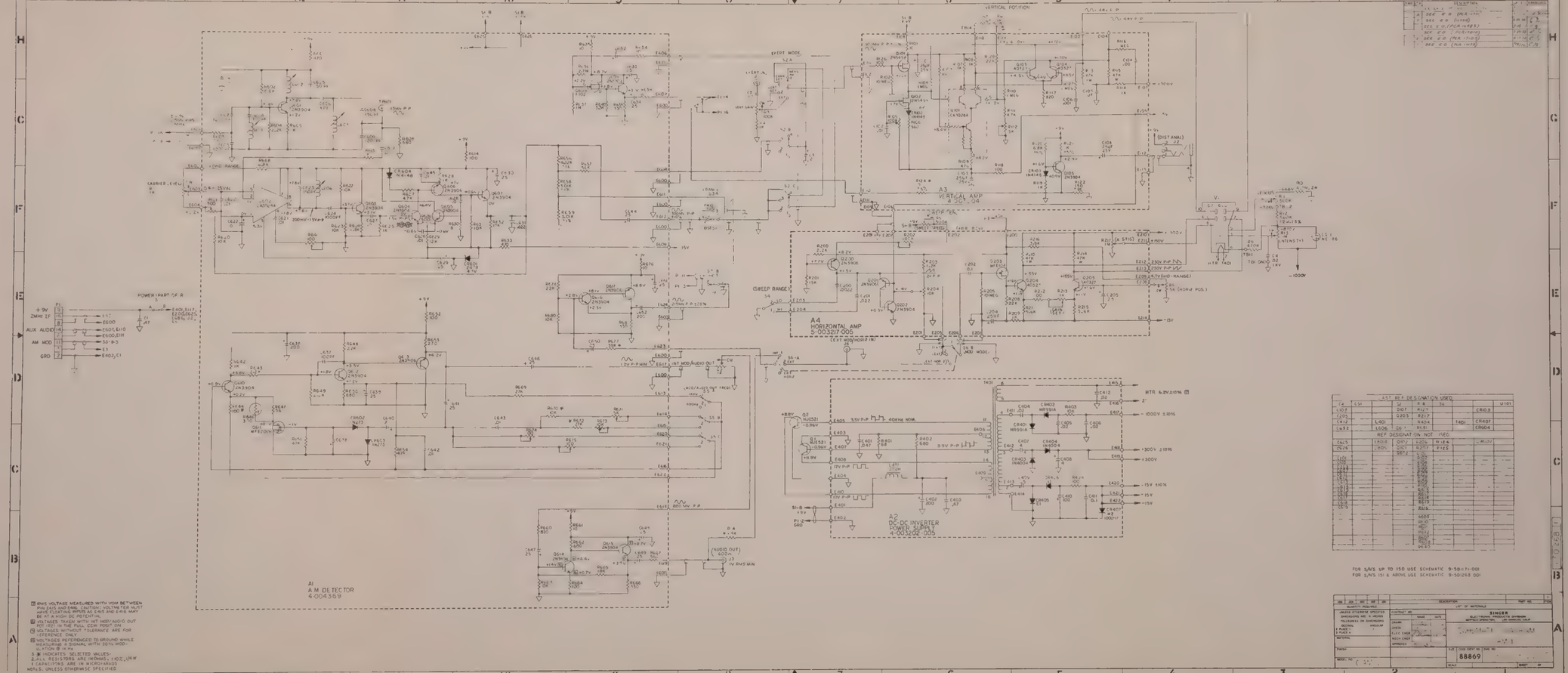


Figure 10-1. OAM-1, Schematic Diagram

10-3/10-4

SECTION XI

OAM-1 PARTS LIST

OAM-1 MAIN ASSEMBLY

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
A1	AM Detector Board Assembly	004369-005	Singer		1
A2	H. V. Power Supply Board Assembly	003202-005	Singer		1
A3	Vertical Amplifier Board Assembly	003204-009	Singer		1
A4	Horizontal Amplifier Board Assembly	003217-005	Singer		1
C1	Capacitor, Metalized Plastic, 20%, 250 V dc, 0.47 μF	900001-021	Amperex	Type C280AE	1
C4	Capacitor, Ceramic Disc, 20%, 1000 V dc, 0.02 μF	900012-012	Sprague	5QA-S20	1
DS1	Lamp, Neon	925008-011	G. E.	Type NE-86	1
P1	Connector, Plug	910071-001	Amphenol	26-159-16	1
Q1, Q2	Transistor, Silicon NPN	958001-004	Motorola	MJE 521	2
R6, R13	Resistor, Variable, Concentric, ±30%	003215-002	Chicago Tele Supply	Type C2-45	2
R7	Resistor, Carbon, 1/4W, 10%, 2.2k	945000-041	Allen-Bradley	Type CB	1
R8, R11	Resistor, Variable, Concentric, ±30%	003215-001	Chicago Tele Supply	Type C2-45	2
R9	Resistor, Carbon, 1/4W, 10%, 470k	945000-069	Allen-Bradley	Type CB	1
R10	Resistor, Carbon, 2W, 10%, 4.7M	945003-081	Allen-Bradley	Type HB	1
R12	Resistor, Carbon, 1/2W, 5%, 560k	945001-228	Allen-Bradley	Type EB	1
S3, R1	Switch/Pot, Concentric	003210-003	Chicago Tele Supply	Type C212/45	1
S4, R5	Switch/Pot, Concentric	003210-002	Chicago Tele Supply	Type C212/45	1
V1	Cathode Ray Tube	917000-001	Telefunken	Type D7-16GJ	1

OAM-1 FRONT PANEL ASSEMBLY

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
C2	Capacitor, Metalized Plastic, 20%, 250V dc, 0.1 μF	900001-013	Amperex	Type C280AE	1
C3	Capacitor, Elect., 25V dc, 2 μF	900023-016	Sprague	TE1201	1
J1	Connector, BNC	910132-001	Gremar	Type UG-1094A/U	1
J2	Littel Jax	910152-001	Switchcraft	S-138	1
J3, J4	Connector, BNC	910132-001	Gremar	Type UG-1094A/U	2
R4	Resistor, Carbon, 1/4W, 10%, 1k	945000-037	Allen-Bradley	Type CB	1
R14	Resistor, Selected, Carbon, 1/4W, 10% 820 ohm Nominal	945000-059	Allen-Bradley	Type CB	1
S1, S6, R2	Switch/Pot, Concentric	003407-003	Chicago Tele Supply	Type 212/45	1
S2, R3	Switch/Pot, Concentric	003407-001	Chicago Tele Supply	Type C212/45	1
S5	Switch, Rotary	003214-003	Chicago Tele Supply	Type 223	1

OAM-1 AM DETECTOR BOARD ASSEMBLY A1

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
C601	Capacitor, Metalized Plastic, 20%, 250 V dc, 0.1 μF	900001-013	Amperex	C280AE	1
C602, 603	Capacitor, Mica, 5%, 100 V dc, 1200 pF	900003-057	Electro Motive Mfg	DM-15	2
C604, 605	Capacitor, Mica, 5%, 500 V dc, 150 pF	900003-034	Electro Motive Mfg	DM-15	2
C606	Capacitor, Mica, 3 ± .5 pF, 500 V dc	900003-003	Electro Motive Mfg	DM-15	1
C607	Not used				0
C608	Capacitor, Mica, 5%, 500 V dc, 150 pF	900003-034	Electro Motive Mfg	DM-15	1
C609	Capacitor, Mica, 5%, 100 V dc, 1200 pF	900003-057	Electro Motive Mfg	DM-15	1
C610, 645	Capacitor, Metalized Plastic, 20%, 250 V dc, 0.01 μF	900001-001	Amperex	C280AE	2
C66 thru C619	Not used				0

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
C620, 621	Capacitor, Metalized Plastic, 20%, 250 V dc, 0.01 μF	900001-001	Amperex	C280AE	2
C622	Capacitor, Elect., 25 V dc, 10 μF	900023-017	Sprague	TE-1204	1
C623	Capacitor, Mica, 5%, 500 V dc, 150 pF	900003-034	Electromotive	DM-15	1
C624	Capacitor, Mica, 5%, 100 V dc, 1000 pF	900003-056	Electromotive	DM-15	1
C625	Not used				0
C626, 627, 628	Capacitor, Metalized Plastic, 20%, 250 V dc, 0.01 μF	900001-001	Amperex	C280AE	3
C629, 630	Capacitor, Elect., 25 V dc, 25 μF	900039-001	Gen. Inst. Corp.	984-2203	2
C631	Capacitor, Metalized Plastic, 20%, 250 V dc, 022 μF	900001-005	Amperex	C280AE	1
C632	Capacitor, Elect., 25 V dc, 2 μF	900023-016	Sprague	TE-1201	1
C633, 634	Capacitor, Elect., 25 V dc, 25 μF	900039-001	Gen. Inst. Corp.	924-2203	2
C635	Capacitor, Elect., 25 V dc, 2 μF	900023-016	Sprague	TE-1201	1
C636, 652	Capacitor, Elect., 15 V dc, 200 μF	900039-002	Gen. Inst. Corp.	984-1733	2
C637	Capacitor, Mica, 5%, 500 V dc, 100 pF	900003-030	Electromotive	DM-15	1
C638	Capacitor, Elect., 25 V dc, 2 μF	900023-016	Sprague	TE-1201	1
C639	Capacitor, Elect., 25 V dc, 25 μF	900039-001	Gen. Inst. Corp.	984-2203	1
C640	Capacitor, Elect., 25 V dc, 2 μF	900023-016	Sprague	TE-1201	1
C641	Capacitor, Elect., 25 V dc, 25 μF	900039-001	Gen. Inst. Corp.	984-2203	1
C642, 643	Capacitor, Metalized Plastic, 20%, 250 V dc, 0.01 μF	900001-001	Amperex	C280AE	2
C644-651	Capacitor, Elect., 25 V dc, 25 μF	900039-001	Gen. Inst. Corp.	984-2203	8
CR601	Diode Zener, 5%, 400 mW, 5.1 V	913004-005	Motorola	MZ-500-9	1
CR602, 603	Diode, Germanium	913005-001	Transitron	IN273	2
CR604	Diode, Silicon	913007-002	General Elect.	IN4148	1
L601-603	Inductor, Variable, 30 - 60 μH	906006-003	Precision Coil	L57-2CT F4	3
L604, 605	Not used				0

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
L606	Inductor, Variable, 30-60 μH	906006-003	Precision Coil	L57-2CT F4	1
Q601	Transistor, Silicon NPN	958000-001	Motorola	2N3904-5	1
Q602	Not used				0
Q603, 604, 605	Transistor, Silicon NPN	958000-001	Motorola	2N3904-5	3
Q606	Transistor, Silicon PNP	958000-002	Motorola	2N3906-5	1
Q607	Transistor, Silicon NPN	958000-001	Motorola	2N3904-5	1
Q608	Transistor, FET	958031-003	Siliconics	E102	1
Q609, 610	Transistor, Silicon NPN	958000-001	Motorola	2N3904-5	2
Q611	Transistor, FET	958044-003	Motorola	MFE2006	1
Q612	Transistor, Silicon NPN	958000-001	Motorola	2N3904-5	1
Q613	Transistor, Silicon PNP	958000-002	Motorola	2N3906-5	1
Q614, 615, 616	Transistor, Silicon NPN	958000-001	Motorola	2N3904-5	3
Q617	Transistor, Silicon PNP	958000-002	Motorola	2N3906-5	1
R601	Resistor, Carbon, 1/4W, 10%, 470 ohms	945000-033	Allen-Bradley	CB	1
R602	Resistor, Carbon, 1/4W, 10%, 6.8k	945000-047	Allen-Bradley	CB	1
R603	Resistor, Carbon, 1/4W, 10%, 56 ohms	945000-022	Allen-Bradley	CB	1
R604	Resistor, Carbon, 1/4W, 10%, 2.2k	945000-041	Allen-Bradley	CB	1
R605	Resistor, Carbon, 1/4W, 10%, 1k	945000-037	Allen-Bradley	CB	1
R606	Resistor, Carbon, 1/4W, 10%, 680 ohms	945000-035	Allen-Bradley	CB	1
R607-612	Not used				0
R613	Resistor, Carbon, 1/4W, 10% 1k	945000-037	Allen-Bradley	CB	1
R614	Resistor, Carbon, 1/4W, 10%, 100 ohms	945000-025	Allen-Bradley	CB	1
R615 thru R619	Not used				0
R620	Resistor, Carbon, 1/4W, 10%, 10k	945000-049	Allen-Bradley	CB	1
R621	Resistor, Variable, ±30%, 500 ohms	945000-003	Chicago Tele Supply	X201	1

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
R622, 623	Resistor, Carbon, 1/4W, 10%, 10k	945000-049	Allen-Bradley	CB	2
R624	Resistor, Carbon, 1/4W, 10%, 1.8k	945000-040	Allen-Bradley	CB	1
R625	Resistor, Carbon, 1/4W, 10%, 1k	945000-037	Allen-Bradley	CB	1
R626	Resistor, Variable, ± 30%, 500 ohms	945000-003	Chicago Tele Supply	X201	1
R627	Resistor, Carbon, 1/4W, 10%, 4.7k	945000-045	Allen-Bradley	CB	1
R628	Resistor, Carbon, 1/4W, 10%, 1k	945000-037	Allen-Bradley	CB	1
R629	Resistor, Carbon, 1/4W, 10%, 12k	945000-050	Allen-Bradley	CB	1
R630	Resistor, Carbon, 1/4W, 10%, 18 ohms	945000-016	Allen-Bradley	CB	1
R631	Resistor, Carbon, 1/4W, 10%, 10k	945000-049	Allen-Bradley	CB	1
R632	Resistor, Carbon, 1/4W, 10%, 10k	945000-049	Allen-Bradley	CB	1
R633	Resistor, Carbon, 1/4W, 10%, 470 ohms	945000-033	Allen-Bradley	CB	1
R643, 635	Resistor, Carbon, 1/4W, 10%, 10 ohms	945000-013	Allen-Bradley	CB	2
R636	Resistor, Carbon, 1/4W, 10%, 2.7M	945000-078	Allen-Bradley	CB	1
R637	Resistor, Carbon, 1/4W, 10%, 1M	945000-073	Allen-Bradley	CB	1
R638	Resistor, Carbon, 1/4W, 10%, 330 ohms	945000-031	Allen-Bradley	CB	1
R639	Resistor, Carbon, 1/4W, 10%, 100 ohms	945000-025	Allen-Bradley	CB	1
R641	Resistor, Variable, ±30%, 100 ohms	945007-001	Chicago Tele Supply	X201	1
R642	Resistor, Carbon, 1/4W, 10%, 1k	945000-037	Allen-Bradley	CB	1
R643	Resistor, Carbon, 1/4W, 10%, 2.2k	945000-041	Allen-Bradley	CB	1
R644	Resistor, Selected, Carbon, 1/4W, 10%, 100 ohm Nominal	945000-025	Allen-Bradley	CB	1
R645	Resistor, Carbon, 1/4W, 10%, 3.3k	945000-043	Allen-Bradley	CB	1
R646	Resistor, Thermistor, ±2%, 300 ohms	945070-001	Corning	C20	1

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
R647	Resistor, Carbon, 1/4W, 10%, 50 ohms	945000-002	Allen-Bradley	CB	1
R648, 649	Resistor, Carbon, 1/4W, 10% 2.2k	945000-041	Allen-Bradley	CB	2
R650	Resistor, Carbon, 1/4W, 10%, 680Ω	945000-035	Allen-Bradley	CB	1
R651	Resistor, Carbon, 1/4W, 10%, 47k	945000-057	Allen-Bradley	CB	1
R652	Resistor, Carbon, 1/4W, 10%, 100 ohms	945000-025	Allen-Bradley	CB	1
R653	Resistor, Carbon, 1/4W, 10%, 270 ohms	945000-030	Allen-Bradley	CB	1
R654	Resistor, Carbon, 1/4W, 10%, 47k	945000-057	Allen-Bradley	CB	1
R655	Resistor, Carbon, 1/4W, 10%, 10k	945000-049	Allen-Bradley	CB	1
R656	Resistor, Film, 1%, 4.02k	945016-251	Amer. Compt.	RN60D	1
R657	Resistor, Carbon, 1/4W, 10%, 56k	945000-058	Allen-Bradley	CB	1
R658, 659	Resistor, Film, 1%, 3.01k	945016-239	Amer. Compt.	RN60D	2
R660	Resistor, Carbon, 1/4W, 10%, 820 ohms	945000-039	Allen-Bradley	CB	1
R661	Resistor, Carbon, 1/4W, 10%, 10 ohms	945000-013	Allen-Bradley	CB	1
R662	Resistor, Carbon, 1/4W, 10%, 680 ohms	945000-035	Allen-Bradley	CB	1
R663	Resistor, Carbon, 1/4W, 10%, 10k	945000-049	Allen-Bradley	CB	1
R664	Resistor, Carbon, 1/4W, 10%, 100 ohms	945000-025	Allen-Bradley	CB	1
R665	Resistor, Carbon, 1/4W, 10%, 18k	945000-053	Allen-Bradley	CB	1
R666	Resistor, Carbon, 1/4W, 10%, 330 ohms	945000-031	Allen-Bradley	CB	1
R667	Resistor, Carbon, 1/4W, 10%, 560 ohms	945000-034	Allen-Bradley	CB	1
R668	Resistor, Carbon, 1/4W, 10%, 6.8k	945000-047	Allen-Bradley	CB	1
R669	Resistor, Carbon, 1/4W, 10%, 27k	945000-054	Allen-Bradley	CB	1
R670	Resistor, Selected, Carbon, 1/4W, 10%, 10k Nominal	945000-049	Allen-Bradley	CB	1

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
R671	Resistor, Variable, ±30%, 5k	945007-006	Chicago Tele Supply	X201	1
R672	Resistor, Selected, Carbon, 1/4W, 10%, 27k Nominal	945000-054	Allen-Bradley	CB	1
R673	Resistor, Variable, ±30%, 10k	945007-007	Chicago Tele Supply	X201	1
R674, 675	Resistor, Variable, ±30%, 100 ohms	945007-001	Chicago Tele Supply	X201	2
R676	Resistor, Carbon, 1/4W, 10%, 10 ohms	945000-013	Allen-Bradley	CB	1
R677	Resistor, Selected, Carbon, 1/4W, 10%, 39k Nominal	945000-056	Allen-Bradley	CB	1
R678	Resistor, Carbon, 1/4W, 10%, 18k	945000-053	Allen-Bradley	CB	1
R679	Not used				0
R680	Resistor, Carbon, 1/4W, 10%, 10k	945000-049	Allen-Bradley	CB	1
R681	Resistor, Carbon, 1/4W, 10%, 330 ohms	945000-031	Allen-Bradley	CB	1
U602	Integrated Circuit	926005-001	RCA	CA3028A	1

OAM-1 HIGH VOLTAGE POWER SUPPLY BOARD ASSEMBLY A2

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
C401	Capacitor, Metalized Plastic, 20%, 250 V dc, 0.047 μF	900001-009	Amperex	C280AE	1
C402	Capacitor, Elect., 15V, 200 μF	900039-002	General Instr.	984-141	1
C403	Capacitor, Metalized Plastic, 20%, 250 V dc, 0.47 μF	900001-021	Amperex	C280AE	1
C404, 405 406	Capacitor, Ceramic Disc, 20%, 1000 V dc, 0.02 μF	900012-012	Sprague	5GA-S20	3
C407, 408	Capacitor, Elect., 350 V dc, 4 μF	900011-001	Cornell-Dubilier	BR	2
C409	Capacitor, Elect., 35 V dc, 25 μF	900000-021	Wima	Printilyt	1
C410	Capacitor, Elect., 25 V dc, 100 μF	900039-004	General Instr.	984-130	1
C411	Capacitor, Ceramic Disc, $^{+80}_{-20}$ %, 500 V dc, 0.1 μF	900012-005	Sprague	41C92	1
C412	Capacitor, Ceramic Disc, 20%, 1000 V dc, 0.02 μF	900012-012	Sprague	5GA-S20	1
CR401, 402	Diode, Rectifier	913043-002	Motorola	MR991A	2
CR403, 404	Diode, Silicon	913001-004	Motorola	IN4004	2
CR405, 406	Diode, Rectifier	913001-002	Motorola	IN4002	2
CR407	Diode, Zener, 10%, 1W, 15V	913004-017	Motorola	MZ1000-17	1
L401	Inductor, Filter, 27 μH	003213-001	Singer		1
R401	Resistor, Carbon, 1/4W, 10%, 68 ohms	945000-023	Allen-Bradley	CB	1
R402	Resistor, Carbon, 1/4W, 10%, 680 ohms	945000-035	Allen-Bradley	CB	1
R403	Resistor, Carbon, 1/4W, 10%, 10k	945000-049	Allen-Bradley	CB	1
R404	Resistor, Carbon, 1/4W, 10%, 100 ohms	945000-025	Allen-Bradley	CB	1
T401	Transformer	003206-001	Singer		1

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
C101	Capacitor, Elect., 25 V dc, 25 μF	900039-001	Gen. Inst. Corp	984-2203	1
C102	Capacitor, Metalized Plastic, 20%, 250 V dc, 0.01 μF	900001-001	Amperex	C280AE	1
C103	Capacitor, Elect., 25 V dc, 25μF	900039-001	Gen. Inst. Corp.	984-2203	1
C104, 106	Capacitor, Ceramic Disc, ±100-0%, 500 V dc, 0.001 μF	900012-002	Erie	861Z5U102P	2
C105	Capacitor, Dipped Plastic, Non-Inductive, ±10%, 400 V dc, 0.1 μF	900005-115	Mallory P.R.	PVC	1
C107	Not used				0
C108	Capacitor, Elect., 25 V dc, 25 μF	900039-001	Gen. Inst. Corp.	984-2203	1
C109, 110	Not used				0
C111, 112	Not used				0
CR101	Not used				0
CR102, 103	Diode, Silicon	913007-001	G.E.	1N4148	2
Q101, 102	Transistor, FED N-Channel	958002-002	Motorola	2N5458	2
Q103, 104	Transistor, Silicon NPN	958004-001	RCA	40327	2
Q105	Transistor, Silicon NPN	958000-001	Motorola	2N3904	1
R101	Resistor, Carbon, 1/4W, 10%, 10 ohms	945000-013	Allen-Bradley	CB	1
R102	Resistor, Carbon, 1/4W, 10%, 10M	945000-085	Allen-Bradley	CB	1
R103	Resistor, Carbon, 1/4W, 10%, 100 ohms	945000-025	Allen-Bradley	CB	1
R104	Resistor, Carbon, 1/4W, 10%, 1M	945000-073	Allen-Bradley	CB	1
R105	Resistor, Variable, 30%, 100k	945010-010	CTS	U201	1
R106	Resistor, Carbon, 1/4W, 10%, 560 ohms	945000-034	Allen-Bradley	CB	1
R107, 108	Resistor, Carbon, 1/4W, 10%, 1k	945000-037	Allen-Bradley	CB	2
R109	Resistor, Carbon, 1/4W, 10%, 470 ohms	945000-033	Allen-Bradley	CB	1
R110	Resistor, Carbon, 1/4W, 10%, 1M	945000-073	Allen-Bradley	CB	1
R111	Resistor, Carbon, 1/4W, 10%, 4.7k	945000-045	Allen-Bradley	CB	1
R112	Resistor, Variable, ±30%, 5k	945010-006	CTS	U201	1

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
R113, 115	Resistor, Carbon, 1W, 10%, 47k	945002-057	Allen-Bradley	CB	2
R114	Resistor, Carbon, 1/4W, 10%, 470 ohms	945000-033	Allen-Bradley	CB	1
R116	Resistor, Carbon, 1/4W, 10%, 1M	945000-073	Allen-Bradley	CB	1
R117	Resistor, Carbon, 1/4W, 10%, 820 ohms	945000-036	Allen-Bradley	CB	1
R118	Resistor, Carbon, 1/4W, 10%, 100 ohms	945000-025	Allen-Bradley	CB	1
R119	Resistor, Carbon, 1/4W, 10%, 1k	945000-037	Allen-Bradley	CB	1
R120	Resistor, Carbon, 1/4W, 5%, 6.8k	945000-182	Allen-Bradley	CB	1
R121	Resistor, Carbon, 1/4W, 5%, 1k	945000-162	Allen-Bradley	CB	1
R122	Resistor, Carbon, 1/4W, 5%, 150 ohms	945000-142	Allen-Bradley	CB	1
R123	Not used				0
R124	Resistor, Selected, Carbon, 1/4W, 5%, 91 ohms Nominal	945000-137	Allen-Bradley	CB	1
R125	Not used				0
R126	Resistor, Carbon, 1/4W, 10%, 100 ohms	945000-025	Allen-Bradley	CB	1
R127	Resistor, Carbon, 1/4W, 10%, 1M	945000-073	Allen-Bradley	CB	1
R128	Resistor, Carbon, 1/4W, 10%, 22k	945000-053	Allen-Bradley	CB	1
R129	Not used				0
U101	Integrated Circuit	926005-001	RCA	CA3028A	1

OAM-1 HORIZONTAL AMPLIFIER BOARD ASSEMBLY A4

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
C200	Capacitor, Dipped Plastic, Non-Inductive, 10%, 400 V, 0.0022 μF	900005-101	Mallory	PVC	1
C201	Capacitor, Dipped Plastic, Non-Inductive, 10%, 200 V, 0.022 μF	900005-004	Mallory	PVC	1
C202	Capacitor, Metalized Plastic, 20%, 250 V dc, 0.1 μF	900001-013	Amperex	C280AE	1
C203	Not used				0

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
C204, 205	Capacitor, Elect., 35 V dc, 25 μF	900000-021	Wima	Printilyt	2
Q200, 201	Transistor, Silicon PNP	958000-002	Motorola	2N3906-5	2
Q202	Transistor, Silicon NPN	958000-001	Motorola	2N3904-5	1
Q203	Transistor, FET N-Channel	958002-002	Motorola	2N5458	1
Q204, 205	Transistor, Silicon NPN	958004-001	RCA	40327	2
R200	Resistor, Carbon, 1/4W, 10%, 2.2k	945000-041	Allen-Bradley	CB	1
R201	Resistor, Carbon, 1/4W, 10%, 15k	945000-051	Allen-Bradley	CB	1
R202	Resistor, Variable, ±30%, 100k	945010-010	Chicago Tele Supply	U201	1
R203	Resistor, Carbon, 1/4W, 10%, 1.2k	945000-038	Allen-Bradley	CB	1
R204	Resistor, Variable, ±30%, 10k	945010-007	Chicago Tele Supply	U201	1
R205	Resistor, Carbon, 1/4W, 10%, 10M	945000-085	Allen-Bradley	CB	1
R208	Resistor, Carbon, 1/4W, 10%, 22k	945000-053	Allen-Bradley	CB	1
R209	Resistor, Carbon, 1/4W, 10%, 1k	945000-037	Allen-Bradley	CB	1
R210	Resistor, Carbon, 1W, 10%, 47k	945002-057	Allen-Bradley	GB	1
R211	Resistor, Carbon, 1/4W, 10%, 5.6k	945000-046	Allen-Bradley	CB	1
R212	Resistor, Carbon, 1/4W, 10%, 100 ohms	945000-025	Allen-Bradley	CB	1
R213	Resistor, Variable, ±30%, 1k	945010-004	Chicago Tele Supply	U201	1
R214	Resistor, Carbon, 1W, 10%, 47k	945002-057	Allen-Bradley	CB	1
R215	Resistor, Carbon, 1/4W, 10%, 5.6k	945000-046	Allen-Bradley	CB	1
R216	Resistor, Carbon, 1/4W, 10%, 3.9k	945000-044	Allen-Bradley	CB	1
R217	Resistor, Variable, ±30%, 1M	945010-013	Chicago Tele Supply	U201	1

SECTION XII
ODM-1 INSTALLATION

12.1 INSTALLATION PROCEDURE

To install ODM-1 in the Mainframe:

a. Remove blank plate covering plug-in aperture by turning the two screws one-quarter turn CCW.

b. Remove protective cover on connector at rear of aperture.

c. Insert ODM-1 until flush with front panel.

> **CAUTION**
>
> Early FM-10 Mainframes have unventilated cases and will overheat when used with the ODM-1 plug-in. A vented replacement case is supplied with the ODM-1 to owners of unvented Mainframes. Ensure that case is vented before installing ODM-1.

d. Turn locking pawl CW until plug-in is firmly locked.

SECTION XIII

ODM-1 THEORY OF OPERATION

13.1 INTRODUCTION

This section consists of the circuit description of the ODM-1 plug-in module. The information is presented to assist the user in the troubleshooting and maintenance of the unit. Refer to the detailed block diagram, Figure 13-1 and the schematic diagram, Figure 15-1.

13.2 THEORY OF OPERATION

13.2.1 GENERAL. The ODM-1 plug-in module derives its operating power and signal input from the mainframe via the rear connector, P1. It contains its own power switch to permit use of the mainframe while the plug-in is switched off. High voltage power supplies for the CRT are also developed within the module. There are four sub-assemblies in the ODM-1; 2 MHz IF board, A1, high voltage power supply board, A2, vertical amplifier board, A3, and horizontal amplifier board, A4. The circuitry contained in the ODM-1 may be divided into six sections: operate and overload lamp circuitry, discriminator output circuitry, vertical deflection circuitry, horizontal deflection circuitry, internal modulation circuitry and power supply circuitry.

13.2.2 OPERATE AND OVERLOAD LAMP CIRCUITRY. A 2 MHz active filter consisting of Q501, L501, L502, and L503 amplifies and filters the 2 MHz IF signal at pin 16 of connector P1. The amplified output is buffered by Q503 and amplified by Q504. Level detector, CR502/Q505/C526, rectifies the IF signal and this output is applied to two potentiometers, R527 and R528. Potentiometer R528 is adjusted to fire the operate lamp schmidt trigger, Q506/Q507, when the level of the 2 MHz at pin 16 of connector P1, is 2.5 mV. This triggers the operate lamp switch, Q508 and OPER lamp, DS1, lights. R527 is adjusted to fire the overload schmidt trigger, Q509/Q510, with 25 mV rms (2.5 mV rms + 20 dB) at the 2 MHz IF input, pin 16 of connector, P1 which triggers the overload lamp switch, Q511, and OVLD lamp, DS2, lights. Interlock diode, CR503, prevents both lamps being lit simultaneously.

13.2.3 DISCRIMINATOR OUTPUT CIRCUITRY. The output of the 2 MHz active filter is also applied to the limiter-discriminator, U501. The demodulated output is buffered by Q502 and applied to pin 5 of connector, P1. The buffered output of Q502 is also amplified by the distorition analyzer amplifier, Q105, for use at the DIST ANAL output connector, J2.

13.2.4 VERTICAL DEFLECTION CIRCUITRY. The output of the limiter-discriminator, U501, is also applied to the voltage divider string, R2/R3/R4, through potentiometer, R516. DEV RANGE switch, S2, selects a voltage from the voltage divider string and when the VERT IN switch, S1, is in the INT position, the recovered audio is amplified by the recovered audio amplifier, Q512/Q513/Q514, and applied to the mainframe via pin 14 of connector, P1.

The signal level selected by the DEV RANGE switch, S2, is also applied to the vertical deflection amplifier, Q101/U101/Q103/Q104, and VERT CENT control, R9, sets the bias of U101B. Q102 and U101C are constant current sources for the vertical deflection amplifier.

13.2.5 HORIZONTAL DEFLECTION CIRCUITRY. The sweep generator contains a current source, Q200, and a regenerative trigger, Q201/Q202. Sweep speed is controlled by SWEEP RANGE switch, S3, and SWEEP SPEED control, R11. The output level is controlled by variable resistor, R204. Synchronization is provided by the vertical signal output of Q104. The sweep generator output is applied to buffer amplifier, Q203, when MOD MODE switch, S4, is in either the INT or EXT position. The output of buffer amplifier, Q203, is applied to the dc-coupled horizontal deflection amplifier, Q204/Q205, having differential outputs which drive the horizontal deflection plates of the CRT. HORIZ CENTER control, R12, sets the bias of Q205. The horizontal amplifier may be driven from an external source connected to the EXT MOD/HORIZ IN receptacle, J4, when the MOD MODE switch, S4, is in the EXT HORIZ position. The mainframe may be modulated from the EXT MOD/HORIZ IN receptacle, J4, when the MOD MODE switch, S4, is in either the EXT or INT COMB positions via the modulation amplifier, U102, through pin 12 of connector, P1.

13.2.6 INTERNAL MODULATION CIRCUITRY. The 1 kHz Wein-bridge oscillator, Q515/Q516 is buffered by Q517 and automatically leveled by level detector, CR504/CR505 and ALC control, Q518. The output of the oscillator is impressed across the INT MOD/AUDIO OUT control, R13.

The wiper of R13 is connected to the audio driver amplifier, Q519/Q520. The output of Q520 is applied to the AUDIO OUT connector, J3. When the MOD MODE switch, S4, is in the INT COMB position, the output from the Wein-bridge oscillator is amplified by the modulation amplifier, U102 and applied to the mainframe through pin 12 of connector, P1.

13.2.7 POWER SUPPLY CIRCUITRY. The power supply is a dc-to-dc inverter that converts +9 volts from the mainframe when the PWR switch, S1, is closed to -1000 volts and +300 volts required by the CRT. The inverter also supplies -15 volts required by the vertical and horizontal deflection amplifiers and 2 MHz IF board.

The 6.2V rms required by the CRT heater is also supplied. The inverter consists of a 40 kHz oscillator, Q1/Q2, a power transformer, T401, and three voltage doublers, CR401/CR402, CR403/CR404, and CR405/CR406. The astigmatism control, R217, utilizes the +300 vdc while the FOCUS and INTENSITY controls, R21 and R18 respectively, require the -1000V dc.

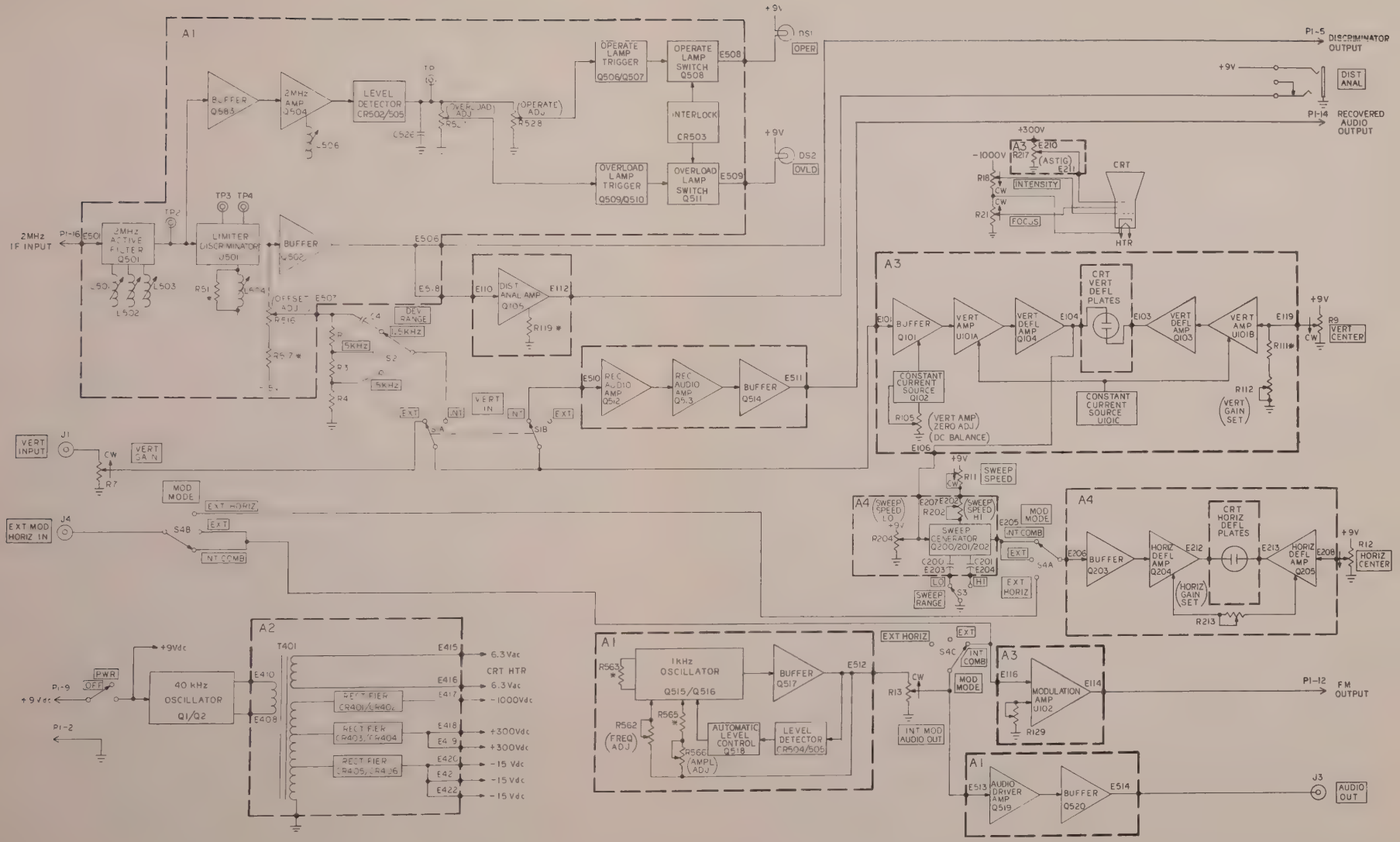


Figure 13-1. Detailed Block Diagram, Model ODM-1

SECTION XIV
ODM-1 MAINTENANCE

14.1 INTRODUCTION

This section contains general maintenance, troubleshooting, and alignment information.

> NOTE: Throughout this section, the term 'CRT' denotes the oscilloscope presentation on the ODM-1 module. The word 'Oscilloscope' refers to an external test equipment (Tektronix Model 651B or equivalent).

14.2 GENERAL MAINTENANCE INFORMATION

14.2.1 BASIC REQUIREMENTS. Each ODM-1 module is carefully checked at the factory, and no further internal adjustments are required prior to placing the equipment in operation. In the event of failure or malfunction, troubleshooting or adjustments should be attempted only if proper test equipment is available, and only by qualified technicians.

14.2.2 TEST EQUIPMENT. The test equipment required for checkout, alignment, calibration, and troubleshooting is tabulated in Table 14-1. Minimum parameters are given to aid in the selection of equivalent types.

14.3 MINIMUM PERFORMANCE CHECKOUT PROCEDURE

14.3.1 REMOVAL FROM CASE. The ODM-1 is secured to the case by five screws in the back panel. Remove the five screws and remove the case from the rear.

14.3.2 POWER REQUIREMENTS. All power required by the ODM-1 is supplied by the Mainframe.

TABLE 14-1. TEST EQUIPMENT REQUIREMENTS

TYPE	MINIMUM PARAMETERS	RECOMMENDED MODEL
Audio Oscillator	Frequency range: 45 Hz to 30 kHz Output: adjustable from 50 mV rms to 3 V rms	Hewlett-Packard, Model 200CD
AC VTVM	Frequency response: 50 Hz to 2 MHz Range: measure in the area of 100 to 400 mV rms	Hewlett-Packard Model 400D
Signal Generator	Frequency range: 25 MHz to 150 MHz Output Impedance: 50 Ω nominal Output: adjustable from <6 mV rms to >60 mV rms Stability: Better than ±0.0004%/5 min Leveling: ±1dB	Singer, Model FM-2748
Oscilloscope	Frequency response: 10 MHz	Tektronix, Model 651B
Distortion Analyzer	Capable of measuring distortion <1% at 1 kHz with 1 V rms	Hewlett-Packard, Model 331A
Frequency Counter	Frequency measurement: 1 kHz at 1 V rms input	Hewlett-Packard, Model 5532A
Frequency Meter	ODM-1 must be tested in an FM-10 series Mainframe	Singer, Model FM-10 or FM-10C
VOM	Range: 0 to 1100 V dc, positive and negative	Simpson, Model 269
DC Digital Voltmeter or VTVM	Range: 10 mV to 15 V dc Accuracy: ±3% of reading	Hewlett-Packard, Model 427A
Extender Cable	NA	Singer, Model PC-2653

CAUTION

High voltages are present throughout the unit and appropriate precautions should be taken while operating the unit with cover removed.

14.3.3 FOCUS AND INTENSITY.

a. Turn power switch to ON.

b. Rotate INTENSITY control fully CW.

c. Rotate FOCUS control to mid-range.

d. Set VERT IN switch at EXT.

e. Set MOD MODE switch at INT/COMB.

f. Allow 5 to 10 seconds for the CRT filaments to warm up. Adjust VERT CENTER and HORIZ CENTER controls until CRT trace is centered.

g. Readjust FOCUS and INTENSITY controls for sharpest trace with adequate intensity.

h. Verify that CRT trace is bright enough to see in a normally lit room. Verify that FOCUS, VERT CENTER, and HORIZ CENTER controls are approximately at mid-range.

14.3.4 VERTICAL AND HORIZONTAL CENTER CONTROL RANGE.

a. Rotate VERT CENTER control from fully CW to fully CCW.

b. Verify that CRT trace deflects off calibrated portion vertically when VERT CENTER control is at its extremes.

c. Return VERT CENTER control to mid-range.

d. Rotate HORIZ CENTER control from fully CW to fully CCW.

e. Verify that ends of trace deflect horizontally to at least mid-screen when HORIZ CENTER control is at its extremes.

f. Return HORIZ CENTER control to mid-range.

g. Verify that trace is centered on CRT with controls set at approximately mid-range.

14.3.5 SWEEP RANGE.

a. Rotate VERT GAIN control fully CW.

b. Set VERT IN switch at EXT.

c. Connect Audio Oscillator and AC VTVM to VERT IN jack.

d. Adjust Audio Oscillator frequency to 50 Hz and set AC VTVM to 30 mV scale.

e. Rotate SWEEP SPEED control fully CCW.

f. Set SWEEP RANGE switch at LO.

g. Increase Audio Oscillator output until sine wave on CRT is full scale. Adjust Audio Oscillator frequency for a stationary, one-cycle sine wave on CRT.

h. Verify that Audio Oscillator frequency is less than 50 Hz - approximately 45 Hz.

j. Rotate SWEEP SPEED control fully CW.

k. Set SWEEP RANGE switch at HI.

l. Adjust Audio Oscillator frequency for a stationary, one-cycle sine wave on CRT.

m. Verify that Audio Oscillator frequency is greater than 5000 Hz and is spread out across entire CRT.

n. Rotate SWEEP SPEED control fully CCW.

p. Adjust Audio Oscillator frequency for a stationary, one-cycle sine wave on CRT.

q. Verify that Audio Oscillator frequency is less than 500 Hz - approximately 450 Hz.

r. Set SWEEP RANGE switch at LO.

s. Rotate SWEEP SPEED control fully CW.

t. Adjust Audio Oscillator frequency for a stationary, one-cycle sine wave.

u. Verify that Audio Oscillator frequency is more than 500 Hz - approximately 550 Hz.

14.3.6 VERTICAL SENSITIVITY.

a. Adjust Audio Oscillator frequency to 1 kHz.

b. Adjust SWEEP RANGE switch and SWEEP SPEED control for a stationary pattern on CRT.

c. Adjust output of Audio Oscillator for full scale deflection on CRT.

d. Verify that output of Audio Oscillator is between 22 and 27 mV rms.

14.3.7 VERTICAL AMPLIFIER FREQUENCY RESPONSE.

a. Adjust Audio Oscillator output to obtain exact full scale deflection on CRT at 1 kHz frequency.

b. Increase Audio Oscillator frequency to 30 kHz and note p-p deflection on CRT.

c. Decrease Audio Oscillator frequency to 50 Hz and note p-p deflection on CRT.

d. Verify that signal on CRT did not change more than 3 db or less than 3 divisions p-p from 50 Hz to 30 kHz.

14.3.8 SENSITIVITY CHECK.

a. Install ODM-1 in Mainframe.

b. Set Mainframe frequency controls at 150 MHz and 0-1 KHz (FM-10) or 0-100 Hz (FM-10C) frequency control at OUT.

c. Connect Signal Generator to Mainframe MEASURE INPUT and set Signal Generator for an output of 150 MHz at the rated sensitivity of the Mainframe. Set FM-10C MODE switch at MEAS.

d. Tune Signal Generator until FM-10/FM-10C indicates zero beat.

e. Set FM-10 only at 152 MHz. The OPER indicator should come on with Signal Generator output within the rated sensitivity range of the Mainframe.

f. Increase Signal Generator output by 20 db and verify that OVLD indicator comes on.

14.3.9 5 kHz RANGE GAIN CHECK (FM-10).

a. Set Mainframe 8 MHz and 0-1 KHz dial at OUT, and 10 MHz switch at IN.

b. Set DEV RANGE switch at 5 kHz.

c. Adjust VERT CENTER control until CRT trace is on 0 line.

d. Set Mainframe at 8.005 MHz.

e. Verify that CRT trace is on top line ±1/2 division.

f. Set Mainframe at 7.995 MHz.

g. Verify that CRT trace is on bottom line ±1/2 division.

14.3.10 15 kHz RANGE GAIN CHECK (FM-10).

a. Set Mainframe at 8 MHz and 0-1 KHz frequency control at OUT.

b. Set DEV RANGE switch at 15 kHz.

c. Adjust VERT CENTER control until CRT trace is on 0 line.

d. Set Mainframe at 8.015 MHz.

e. Verify that CRT trace is on top line ±1/2 division.

f. Set Mainframe at 7.985 MHz.

g. Verify that CRT trace is on bottom line ±1/2 division.

14.3.11 5 kHz RANGE GAIN CHECK (FM-10C).

a. Set Mainframe at 000.000, 0-100 Hz frequency control at OUT, and MODE switch to TONE GEN.

b. Set DEV RANGE switch at 5 kHz.

c. Adjust VERT CENTER control so that trace is on 0 center line.

d. Set Mainframe at 000.0050 MHz.

e. Verify that CRT trace is on bottom line ±1/2 division.

14.3.12 15 kHz RANGE GAIN CHECK (FM-10C).

a. Set Mainframe at 000.000, and 0-100 Hz frequency control at OUT.

b. Set DEV RANGE switch at 15 kHz.

c. Adjust VERT CENTER control so that trace is on 0 center line.

d. Set Mainframe at 000.0150 MHz.

e. Verify that CRT trace is on bottom line ±1/2 division.

14.3.13 INTERNAL MODULATION AND VERTICAL GAIN CONTROL CHECK (FM-10).

a. Set Mainframe at 8 MHz, 10 KHz frequency control at V, 0-1 KHz frequency control at 0, and push 10 MHz switch to IN.

b. Set DEV RANGE switch at 5 kHz.

c. Set MOD MODE switch at INT/COMB.

d. Adjust INT MOD/AUDIO OUT control for full-scale deflection of CRT trace.

e. Set Mainframe 10 KHz frequency control at 0 and 100 KHz frequency control at V.

f. Set DEV RANGE switch at 15 kHz. Verify that CRT trace is greater than full scale.

g. Adjust INT MOD/AUDIO OUT control for full-scale deflection of trace.

14.3.14 INTERNAL MODULATION AND VERTICAL GAIN CONTROL CHECK (FM-10C).

a. Set MODE switch at GEN MOD CAL and GEN MOD at IN/ON.

b. Set MOD MODE switch at INT/COMB.

c. Set DEV RANGE switch at 15 kHz.

d. Rotate AUDIO OUT control to maximum and verify that trace exceeds full-scale deflection.

e. Adjust AUDIO OUT control for full-scale deflection of CRT trace.

14.3.15 INTERNAL/COMBINED AND EXTERNAL MODE CHECK (FM-10).

a. Set DEV RANGE switch at 5 kHz.

b. Set Mainframe frequency at 8.0V0 MHz, 0-1 KHz frequency control at 0, and push 10 MHz switch to IN.

c. Adjust INT MOD/AUDIO OUT control for full-scale trace.

d. Set MOD MODE switch at EXT.

e. Connect Audio Oscillator to EXT MOD/HORIZ IN jack.

f. Set Audio Oscillator for 1 kHz output and adjust output level for full-scale deflecti on.

g. Verify that Audio Oscillator output level is 400 mV rms ±10%.

h. Set MOD MODE switch at INT/COMB and verify display of two 1 kHz signals beating.

14.3.16 INTERNAL/COMBINED AND EXTERNAL MODE CHECK (FM-10C).

a. Set DEV RANGE switch at 5 kHz.

b. Set Mainframe at 000.000 MHz, 0-100 Hz frequency control at OUT, MODE switch at GEN MOD CAL, and GENERATOR MODULATION at IN/ON.

c. Adjust INT MOD/AUDIO OUT control for full-scale trace.

d. Set MOD MODE switch at EXT.

e. Connect Audio Oscillator to EXT MOD/HORIZ IN jack.

f. Set Audio Oscillator for 1 kHz output and adjust output level for full-scale deflection.

g. Verify that Audio Oscillator output level is 80 mV rms ±20%.

h. Set MOD MODE switch at INT/COMB and verify display of two 1 kHz signals beating.

14.3.17 EXTERNAL HORIZONTAL SWEEP CAPABILITY.

a. Set MOD MODE switch at EXT HORIZ with Audio Oscillator set at 1 kHz attached to EXT MOD/HORIZ IN jack.

b. Increase Audio Oscillator output until trace is spread over diameter of CRT.

c. Verify that amplitude required for full diameter deflection is less than 500 mV rms.

14.3.18 AUDIO OUTPUT FREQUENCY, LEVEL, AND DISTORTION.

a. Connect AC VTVM and Frequency Counter to AUDIO OUT 1 kHz 600Ω jack.

b. Connect a 600Ω resistive load across the AC VTVM terminals.

c. Rotate INT MOD/AUDIO OUT control fully CW.

d. Note readings on AC VTVM and Frequency Counter.

e. Verify that frequency is 1 kHz ±5%; level should be 1 V rms minimum into 600Ω.

f. Disconnect Frequency Counter from AUDIO OUT 1 kHz 600Ω jack and connect Distortion Analyzer.

g. Calibrate Distortion Analyzer at 1 kHz and note the reading. Distortion should be less than 1%.

14.4 ALIGNMENT AND ADJUSTMENT

14.4.1 HORIZONTAL AMPLIFIER BOARD ASSEMBLY A4, (FIGURE 14-1).

14.4.1.1 Location and Adjustment of the Scope Trace.

a. With power applied to ODM-1, set VERT IN switch S1 at EXT. Turn INTENSITY control fully CW.

b. Rotate HORIZ CENTER R12 and VERT CENTER R9 controls to mid-range. Set MOD MODE switch S6 at INT/COMB.

c. The CRT trace should now be present. If not, vary VERT CENTER and HORIZ CENTER controls until CRT trace is obtained.

d. Center CRT trace. Adjust INTENSITY and FOCUS controls to sharpen trace.

e. Adjust astigmatism control (A4-R217) for maximum sharpness of CRT trace.

f. Adjust gain set control A4-R213 to increase or decrease width of CRT trace.

14.4.1.2 Sweep Range Adjustment.

a. Rotate VERT GAIN control R7 fully CW. Set VERT IN switch at EXT.

b. Connect Audio Oscillator to VERT IN jack J1. Set Audio Oscillator frequency at 45 Hz.

c. Increase Audio Oscillator gain control until sine wave observed on scope is full scale.

d. Turn SWEEP SPEED control R11 fully CCW. Set SWEEP RANGE switch at LO.

e. Adjust A4-R204 to obtain a stationary, one-cycle pattern on CRT.

NOTE: After adjusting R204, it may be necessary to readjust A4-R213 slightly to widen trace to the width of the CRT.

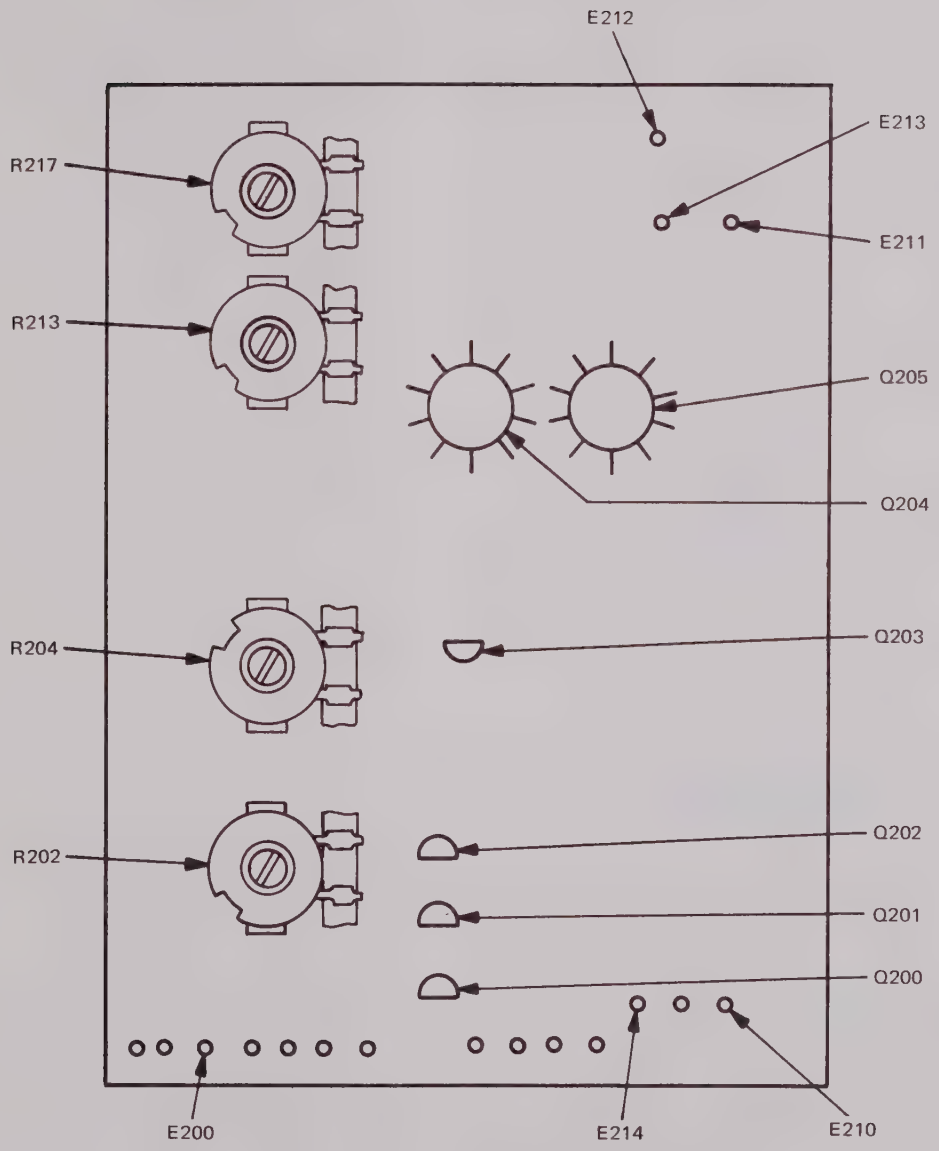


Figure 14-1. Horizontal Amplifier Board Assembly A4

f. Turn SWEEP SPEED control fully CW. Set SWEEP RANGE switch at HI. Increase Audio Oscillator frequency to 5 kHz.

g. Adjust A4-R202 to obtain a stationary, one-cycle pattern on CRT.

h. Repeat steps b through g until no further adjustment is needed.

j. With SWEEP RANGE switch at HI, rotate SWEEP SPEED control fully CCW.

k. Adjust Audio Oscillator for a stationary, one-cycle pattern. The frequency required for this condition should be less than 500 Hz - approximately 450 Hz.

l. Set SWEEP RANGE switch at LO. Rotate SWEEP SPEED control fully CW.

m. Adjust Audio Oscillator frequency for a stationary, one-cycle pattern. The frequency required for this condition should be more than 500 Hz - approximately 550 Hz.

14.4.2 IF AMPLIFIER BOARD ASSEMBLY A1 (FIGURE 14-2).

14.4.2.1 IF Amplifier Tuning.

a. Connect Oscilloscope probe to the emitter of Q503 on IF amplifier board assembly A1.

b. On FM-10, push 10 MHz button to IN and set frequency controls at 011.975 MHz and 0-1 KHz frequency control at OUT.

On FM-10C, set MODE switch at MEAS, frequency controls at 009.9750, and 0-100 Hz frequency control at OUT. Apply 10 MHz time base output from rear panel connector to MEASURE INPUT through an RFA-20 attenuator.

c. Adjust L503 for maximum amplitude on Oscilloscope.

d. On FM-10, set frequency controls at 012.025 MHz.

On FM-10C, set frequency controls at 010.0250 MHz.

e. Adjust L502 for maximum amplitude on Oscilloscope.

f. On FM-10, set frequency controls at 012.000 MHz.

On FM-10C, set frequency controls at 010.0000 MHz.

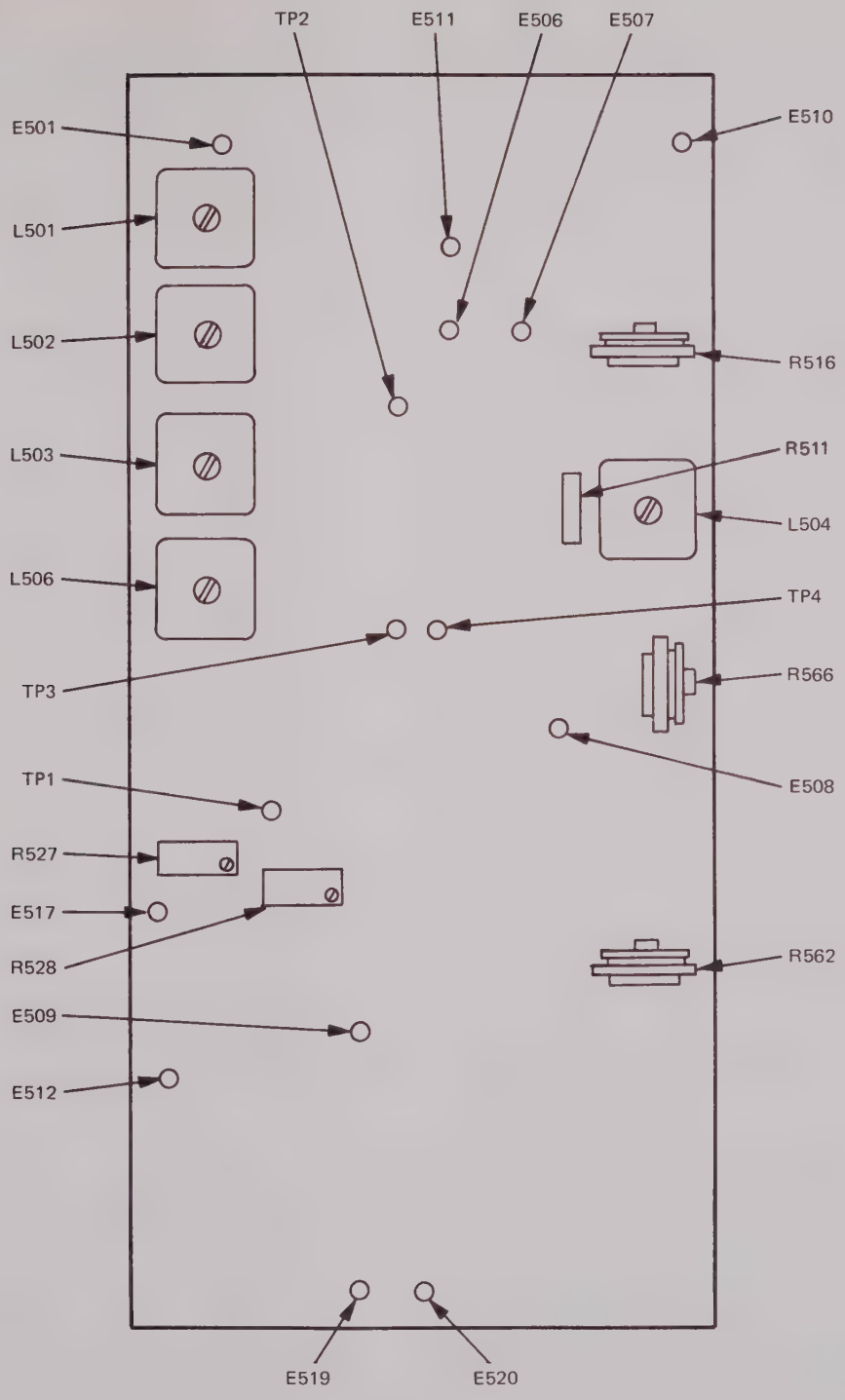


Figure 14-2. IF Amplifier Board Assembly A1

g. Adjust L501 for maximum amplitude on Oscilloscope.

h. Repeat steps b through g until no further peaking can be obtained.

j. Connect DC VTVM to TP-1 and set frequency controls as specified in step f.

k. Adjust L506 for maximum dc voltage (4.9 to 6.5 V dc).

l. Connect a 150-MHz signal source to Mainframe MEAS INPUT jack and set its level to 6 mV rms ±3 db. Set FM-10 frequency controls at 150.000 MHz and AUDIO switch at IN/BEAT. Set FM-10C frequency controls at 150.0000 MHz and MODE switch at MEAS. Tune signal generator for a zero beat. Set FM-10 frequency controls at 152 MHz and AUDIO switch at OUT/MOD. Set FM-10C GEN MOD switch at IN-ON.

m. Set signal level at 2.5 mV rms as measured on RF Voltmeter with high impedance probe at pin E501 and adjust R528 until OPER indicator comes on.

n. Increase level of signal to 25 mV rms at pin E501 and adjust R527 until OVLD indicator comes on and OPER indicator goes out.

p. Set signal level at 2.5 mV rms at pin E501.

q. Connect Oscilloscope probe to TP-4 and adjust L504 for maximum output level. It should be approximately 800 mV p-p.

14.4.2.3 Modulation Oscillator Alignment.

a. Connect AC VTVM and Frequency Counter to AUDIO OUT jack (use BNC to GR plugs).

b. Set AC VTVM at 3 V range.

c. Connect a 600-ohm resistor across VTVM input.

d. Rotate INT MOD/AUDIO OUT control fully CW.

e. Adjust R566 for a 1.05-volt indication on VTVM.

f. Adjust R562 for a 1-kHz ±10 Hz indication on Frequency Counter.

g. If necessary, adjust R566 for 1.05-volt indication on VTVM.

h. Disconnect AC VTVM and Frequency Counter and connect Distortion Analyzer to AUDIO OUT jack.

j. Verify that Distortion Analyzer indicates less than 1% distortion.

14.4.3 VERTICAL AMPLIFIER BOARD ASSEMBLY A3 (FIGURE 14-3).

14.4.3.1 Vertical Balance and Gain Adjustments.

a. Set VERT IN switch at EXT and short VERT IN jack to ground.

b. Set VERT GAIN control fully CW.

c. Set VERT CENTER control at mid-range.

d. Adjust R105 until trace is positioned on center line of CRT graticule.

e. Remove short from VERT IN jack and connect Audio Oscillator to AC VTVM and to VERT IN jack J1. Set frequency for 1 kHz and amplitude for 25 mV rms.

f. Adjust R112 for full scale deflection on CRT. Simultaneously adjust R105 to maintain a centered display.

g. On FM-10, push 10 MHz button to IN and set frequency controls at 012.000 MHz and 0-1 KHz frequency control at OUT.

On FM-10C, set MODE switch at TONE GEN, frequency controls at 000.0000 MHz, and 0-100 Hz frequency control at OUT.

h. Set VERT IN switch at INT.

j. Set DEV RANGE switch at 5 kHz. Zero trace with R516 on IF amplifier board assembly A1.

k. Set DEV RANGE switch at 15 kHz and verify that trace is on zero center line of CRT ±2 divisions. Reset DEV RANGE switch to 5 kHz.

l. Increase setting of Mainframe frequency controls by 5 kHz and select R511 on 2 MHz IF board assembly A1 to place trace on bottom of 5 kHz graticule to within ±5%.

m. Readjust R112 to place trace exactly on bottom of 5 kHz graticule.

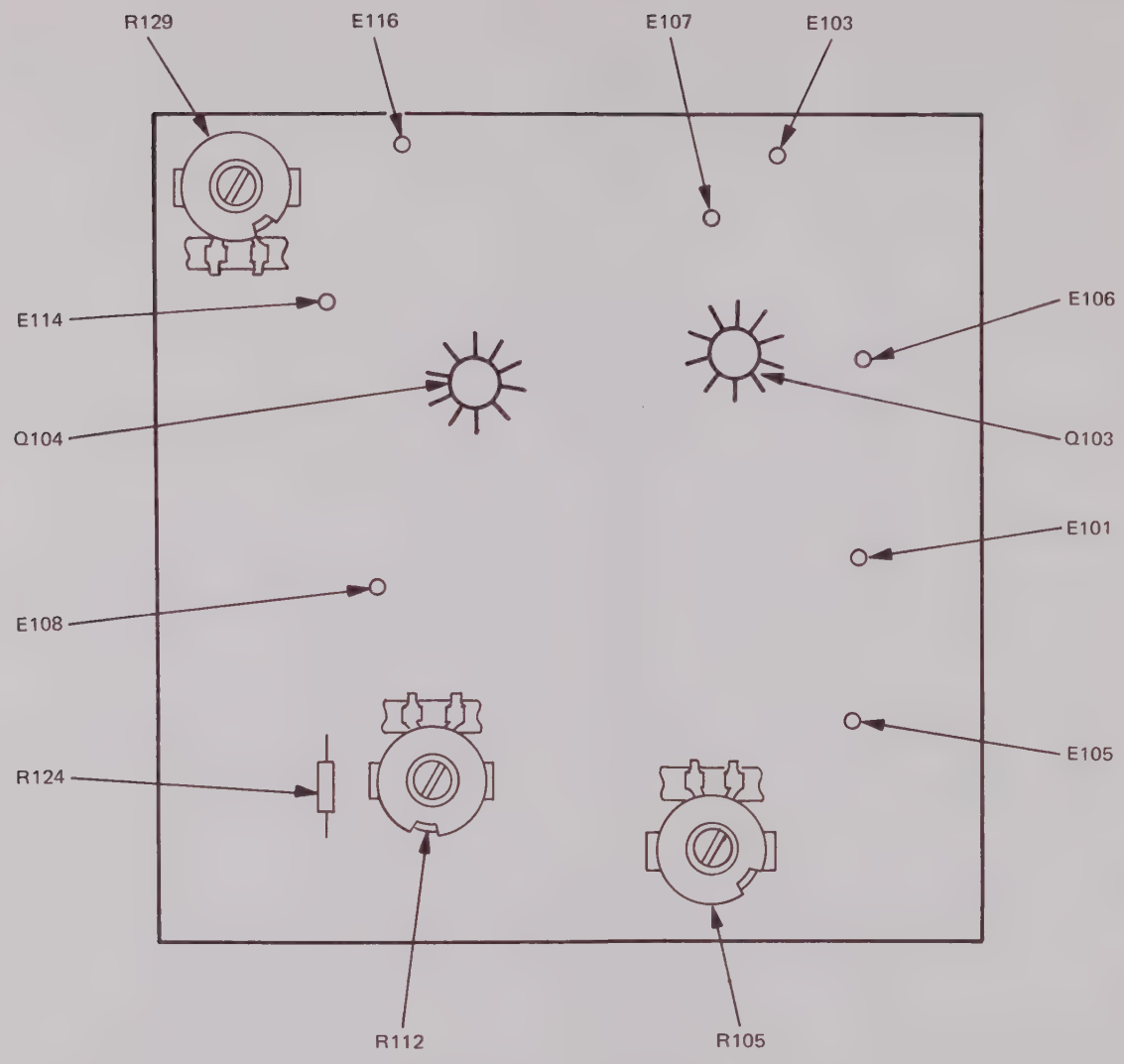


Figure 14-3. Vertical Amplifier Board Assembly A3

n. Set DEV RANGE switch at 15 kHz.

o. Set frequency controls 15 kHz above and below frequency given in step g and check calibration in this range.

p. Set VERT IN switch at EXT.

q. Connect Audio Oscillator and VTVM to VERT IN jack.

r. Rotate VERT GAIN fully CW.

s. Set Audio Oscillator at 1 kHz and adjust level for full-scale deflection on CRT.

t. Verify that input level is 25 mV rms ±10%.

u. Set Audio Oscillator frequency at 50 Hz.

v. Verify that amplitude is greater than 7 divisions p-p on CRT.

w. Set Audio Oscillator frequency at 30 kHz.

x. Verify that level is greater than 7 divisions p-p on CRT.

y. Disconnect Audio Oscillator from VERT IN jack and connect to EXT MOD/HORIZ IN.

z. Set frequency at 1 kHz and output level at 400 mV rms.

aa. Connect AC VTVM from E114 to ground.

ab. Adjust R129 for 500 mV rms indication on AC VTVM.

14.5 FAULT ISOLATION PROCEDURES

Fault isolation procedures are presented to provide a guide in servicing the ODM-1. The procedures follow the sequence of the Minimum Performance Checkout Procedures, Section 14.3, with each subsection keyed to the paragraph in Section 14.3 that first indicates a fault. When a fault is noted during ODM-1 operation, proceed as follows:

a. Perform checkout procedures in Section 14.3.

b. Start fault isolation procedures at the point where minimum performance cannot be satisfied.

c. When the fault is isolated to a subassembly, such as horizontal amplifier A4, refer to the alignment procedure for that subassembly in Section 14.4, and check alignment of subassembly before proceeding with fault isolation.

d. After a fault is repaired, complete the minimum performance checkout procedure to determine if further alignment is necessary.

WARNING

High voltages are present throughout the unit. Appropriate precautions should be taken while operating the instrument with the cover removed.

14.5.1 NO TRACE (14.3.3-f).

a. Remove socket from V1 (CRT) and check V1 voltages per Figure 15-1.

b. If voltages are within tolerance, replace V1.

c. If any voltage is absent or out of tolerance, check voltage source on board A2, A3, or A4 output terminals.

d. If voltages are in tolerance at A2, A3, or A4 output terminals check wiring harness for open or shorted leads.

e. If any voltage is absent or out of tolerance at output terminals of A2, A3, or A4 use voltages and waveforms shown on Figure 15-1 to isolate the fault.

14.5.2 FOCUS DEFECTIVE (14.3.3-g)

a. Check voltage on pin 5 of V1. Voltage should vary over at least a 100-volt span within -650 V dc and -920 V dc as FOCUS control R21 is adjusted to extremes.

b. If voltage is within tolerance, change V1.

c. If voltage is not within tolerance, check for -1000 V dc at E417 on board A2.

d. If voltage is within tolerance at E417, check wiring and neon indicator DS-1.

e. If voltage at E417 is out of tolerance, use Figure 15-1 voltages and waveforms to isolate fault on board A2.

14.5.3 INTENSITY DEFECTIVE (14.3.3-g).

NOTE: The ODM-1 operates in Mainframes designed for 12-V dc operation. The normal maximum intensity is not as high as that of Oscilloscopes designed for 115-V ac operation because a lower power CRT is used to conserve current drain in battery operation.

a. Check voltage on pin 3 of V1 and ensure that voltage varies over a 50-volt span in the range of -850 V dc to -1100 V dc as INTENSITY control R18 is rotated to extremes.

b. If voltage is within tolerance, replace V1.

c. If voltage is out of tolerance, check voltage at E417 of A2.

d. If voltage is in tolerance at E417, check associated wiring and INTENSITY control R18.

e. If voltage at E417 is out of tolerance, use Figure 15-1 voltages and waveforms to isolate fault in board A2.

14.5.4 VERTICAL CENTERING DEFECTIVE (14.3.3-f).

a. Check voltages at pins 9 and 10 of V1. Voltage should be adjustable over an 80 V minimum span within the range of +95 V dc to +235 V dc as the VERT CENTER control is rotated to extremes.

b. If voltages are within tolerance, replace V1.

c. If voltages are not within tolerance, check voltage at E119 on board A3. This voltage should vary from less than +0.1 V dc to greater than 2.3 V dc as the VERT CENTER control is rotated to extremes.

d. If voltage at E119 is within tolerance, use voltages and waveforms on Figure 15-1 to isolate fault on board A3.

e. If voltage at E119 is not within tolerance, check R8, R9, and associated wiring.

14.5.5 HORIZONTAL CENTERING DEFECTIVE (14.3.3-f).

a. Check voltages at pins 6 and 7 of V1. Voltages should vary over a 240 V minimum span within the range of 0 V dc to +330 V dc as the HORIZ CENTER control is rotated to extremes.

b. If voltages are within tolerance, replace V1.

c. If voltages are not within tolerance, check voltage at E208 on board A4. This voltage should vary from 0 V dc to +4.8 V dc nominal as HORIZ CENTER control R12 is rotated to extremes.

d. If voltage at E208 is not within tolerance, check voltage at E209. Voltage should be 4.3 V dc to 5.3 V dc.

e. If voltage at E208 is within tolerance, use voltages and waveforms on Figure 15-1 to isolate fault on board A4.

14.5.6 VERT CENTER CONTROL CANNOT ADJUST TRACE OFF SCREEN (14.3.4-b).

Perform procedures of paragraph 14.5.4.

14.5.7 HORIZ CENTER CONTROL CANNOT ADJUST TRACE TO MID-SCREEN (14.3.4-e).

a. Perform procedures of paragraph 14.5.5.

b. Perform procedures of paragraph 14.5.21.

14.5.8 SWEEP SPEED CANNOT ADJUST BELOW 50 Hz ON LOW RANGE (14.3.5-h).

a. On board assembly A4, check resistance of E203 to ground. If resistance is greater than 10 ohms, check wiring of SWEEP RANGE switch S4.

b. If E203 is grounded, check voltage at E202 to ensure that voltage varies over a span of at least 0.6 V dc within the range of +7.4 V dc to +9.9 V dc.

c. If voltage is within tolerance, use voltages and waveforms on Figure 15-1 to isolate fault on board assembly A4.

14.5.9 SWEEP SPEED CANNOT ADJUST ABOVE 5000 Hz ON HIGH RANGE (14.3.5-m).

a. On board assembly A4, check resistance of E203 to ground. If resistance is less than 100 kΩ, check wiring of SWEEP RANGE switch S4.

b. If resistance is greater than 100 kΩ, check voltage at E202 to ensure that voltage varies over a span of at least 0.6 V dc within the range of +7.4 V dc to +9.9 V dc.

14.5.10 SWEEP SPEED CANNOT ADJUST BELOW 500 Hz ON HIGH RANGE (14.3.5-q).

Perform procedures of paragraph 14.5.9.

14.5.11 SWEEP SPEED CANNOT ADJUST ABOVE 500 Hz ON LOW RANGE (14.3.5-u).

Perform procedures of paragraph 14.5.8.

14.5.12 EXTERNAL VERTICAL INPUT SENSITIVITY NOT WITHIN SPECIFICATION LIMITS (14.3.6-d).

a. Apply a 1-kHz signal of 25 mV rms to EXT VERT input connector and check voltage with a scope at E101. Voltage should be 70 mV p-p.

b. If voltage is not 70 mV p-p, check VERT GAIN control R7, R6, and associated wiring.

c. If voltage is 70 mV p-p, use voltages and waveforms on Figure 15-1 to isolate fault.

14.5.13 VERTICAL AMPLIFIER FREQUENCY RESPONSE NOT WITHIN SPECIFICATION LIMITS (14.3.7-d).

a. Check voltage at pin E101. Verify that voltage changes less than 1 db from 50 Hz to 30 kHz.

b. If voltage changes more than 1 db over this range, check C1, R6, R7 (VERT GAIN), S1, and associated wiring.

c. If voltage does not vary more than ±1 db, use voltages and waveforms of Figure 15-1 to isolate fault on board assembly A3.

14.5.14 OPERATE INDICATOR SENSITIVITY NOT WITHIN SPECIFICATION LIMITS (14.3.8-e).

a. Connect high impedance probe of RF Voltmeter to pin E501 and ground. Verify that 2 MHz level is 2.5 mV rms ±10%.

b. If level is not 2.5 mV rms ±10% at pin E501, the fault is in the Mainframe. Refer to Maintenance Section of Mainframe manual.

c. If level is 2.5 mV rms ±10% at pin E501, use Figure 15-1 voltages and waveforms to isolate fault on board assembly A1.

14.5.15 OVERLOAD INDICATOR SENSITIVITY NOT WITHIN SPECIFICATION LIMITS (14.3.8-f).

a. Connect high impedence probe of RF Voltmeter to pin E501 and ground. Verify that 2 MHz level is 25 mV rms ±10%.

b. If level is not 25 mV rms ±10% at pin E501, the fault is in the Mainframe. Refer to Maintenance Section of Mainframe manual.

c. If level is 25 mV rms ±10% at pin E501, use Figure 15-1 voltages and waveforms to isolate fault on board assembly A1.

14.5.16 5-kHz POSITIVE RANGE GAIN NOT WITHIN SPECIFICATION LIMITS (14.3.9-e).

a. Connect DC VTVM to pin E507 and ground. Verify that voltage is +233 mV dc ±20 mV.

b. If voltage is not +233 mV dc ±20 mV at pin E507, use Figure 15-1 voltages and waveforms to isolate fault on board assembly A1.

c. If voltage at pin E507 is correct, check voltage on pin E101 (vertical amplifier board assembly A3). Verify that voltage is +233 mV dc ±20 mV.

d. If voltage at pin E101 is correct, use Figure 15-1 voltages and waveforms to isolate fault on vertical amplifier board assembly A3.

e. If voltage is not +233 mV dc ±20 mV at pin E101, check DEV RANGE switch S2, R2, R3, R4 and associated wiring.

14.5.17 5-kHz NEGATIVE RANGE GAIN NOT WITHIN SPECIFICATION LIMITS (14.3.9-g or 14.3.11-e). Repeat procedures of paragraph 14.5.16 except that voltage at pins E507 and E101 should be -233 mV dc ±20 mV.

14.5.18 15-kHz POSITIVE RANGE GAIN NOT WITHIN SPECIFICATION LIMITS (14.3.10-e). Repeat procedures of paragraph 14.5.16 except that voltage at pins E507 and E101 should be +400 mV dc ±40 mV.

14.5.19 15-kHz NEGATIVE RANGE GAIN NOT WITHIN SPECIFICATION LIMITS (14.3.10-g). Repeat procedures of paragraph 14.5.16 except that voltage at pins E507 and E101 should be -400 mV dc ±40 mV.

14.5.20 INSUFFICIENT VERTICAL AMPLITUDE AT 15 kHz (14.3.13-f or 14.3.14-d).

a. Connect AC VTVM to pin E114 and ground. Verify that voltage is >480 mV.

b. If voltage at pin E114 is >480 mV, the fault is in the Mainframe. Refer to Maintenance Section of Mainframe manual.

c. If voltage at pin E114 is <480 mV, check voltage between pin E116 and ground. Verify that voltage is >113 mV rms.

d. If voltage at pin E116 is >113 mV rms, connect Audio Oscillator to EXT MOD/HORIZ IN jack, set MOD MODE switch at EXT, set oscillator at 400 mV rms and adjust A3-R129 for a 400 mV rms indication at pin E114.

e. If unable to attain correct voltage at pin E114, use Figure 15-1 voltages and waveforms to isolate fault in U102 circuit on vertical amplifier board assembly A3.

f. If voltage at pin E116 is not correct, check R14, R15, R16, and MOD MODE switch S4 wiring. Verify that voltage at pin E513 is 321 mV rms ±10%.

g. If voltage at pin E513 is not correct, check INT MOD/AUDIO OUT control R13 and associated wiring. Verify that voltage at pin E512 is 640 mV rms ±10%.

h. If voltage at pin E512 is not correct, use Figure 15-1 voltages and waveforms to isolate fault in modulation oscillator on board assembly A1.

14.5.21 INSUFFICIENT VERTICAL AMPLITUDE AT 5 kHz IN EXTERNAL MODE WITH FM-10 (14.3.15-g).

a. Connect AC VTVM to EXT MOD/HORIZ IN jack. Verify that voltage is 400 mV rms ±10%.

b. If voltage is not correct, adjust audio oscillator output to obtain this level.

c. If voltage is correct, verify that voltage at pin E114 is 500 mV rms ±5%.

d. If voltage at pin E114 is correct, the fault is in the Mainframe. Refer to Maintenance Section of Mainframe manual.

e. If voltage is not correct at pin E114, perform steps 14.5.20d and 14.5.20e.

14.5.22 INSUFFICIENT VERTICAL AMPLITUDE AT 5 kHz IN EXTERNAL MODE WITH FM-10C (14.3.16-g). Repeat procedures of paragraph 14.5.21 except that voltage should be 80 mV rms ±20%.

14.5.23 EXTERNAL HORIZONTAL SENSITIVITY NOT WITHIN SPECIFICATION LIMITS (14.3.17-c).

a. Set oscillator at 500 mV rms and measure voltage at pin E206.

b. If voltage at E206 is less than 500 mV rms, check S4 and associated wiring.

c. If voltage at E206 is 500 mV rms, use Figure 15-1 voltages to isolate fault on board assembly A4.

14.5.24 AUDIO OUTPUT FREQUENCY NOT WITHIN SPECIFICATION LIMITS (14.3.18-e). Use Figure 15-1 voltages and waveforms to isolate fault on board assembly A1.

14.5.25 AUDIO OUTPUT VOLTAGE NOT WITHIN SPECIFICATION LIMITS (14.3.18-e).

a. Check the level at E513. This level should be greater than 1.2 V p-p. If it is, the fault is in stages Q519 and Q520. Use schematic voltages to further isolate the fault.

b. If the level at E513 is within tolerance, check the level at E512. If the level at E512 differs from the level at E513 check R13, R14, R15, R16, S4 and associated wiring.

c. If the level at E512 is equal to the level at E513 and is less than 1.2 V p-p, use the voltage and waveform information on the schematic to isolate the fault on board assembly A1.

14.5.26 AUDIO DISTORTION NOT WITHIN SPECIFICATION LIMITS (14.3.18-g).

a. Connect Distortion Analyzer to pin E512 and calibrate it at 1 kHz. Distortion should be 0.5% or less.

b. If distortion at pin E512 is greater than 0.5%, use Figure 15-1 voltages and waveforms to isolate fault on board assembly A1.

c. If distortion at pin E512 is less than 0.5% the fault is in stages Q519 and Q520. Use Figure 15-1 voltages and waveforms to isolate the fault.

14.5.27 HIGH VOLTAGE POWER SUPPLY BOARD ASSEMBLY A2. Figure 14-4 is provided as an aid should fault isolation of high voltage power supply board assembly A2 become necessary.

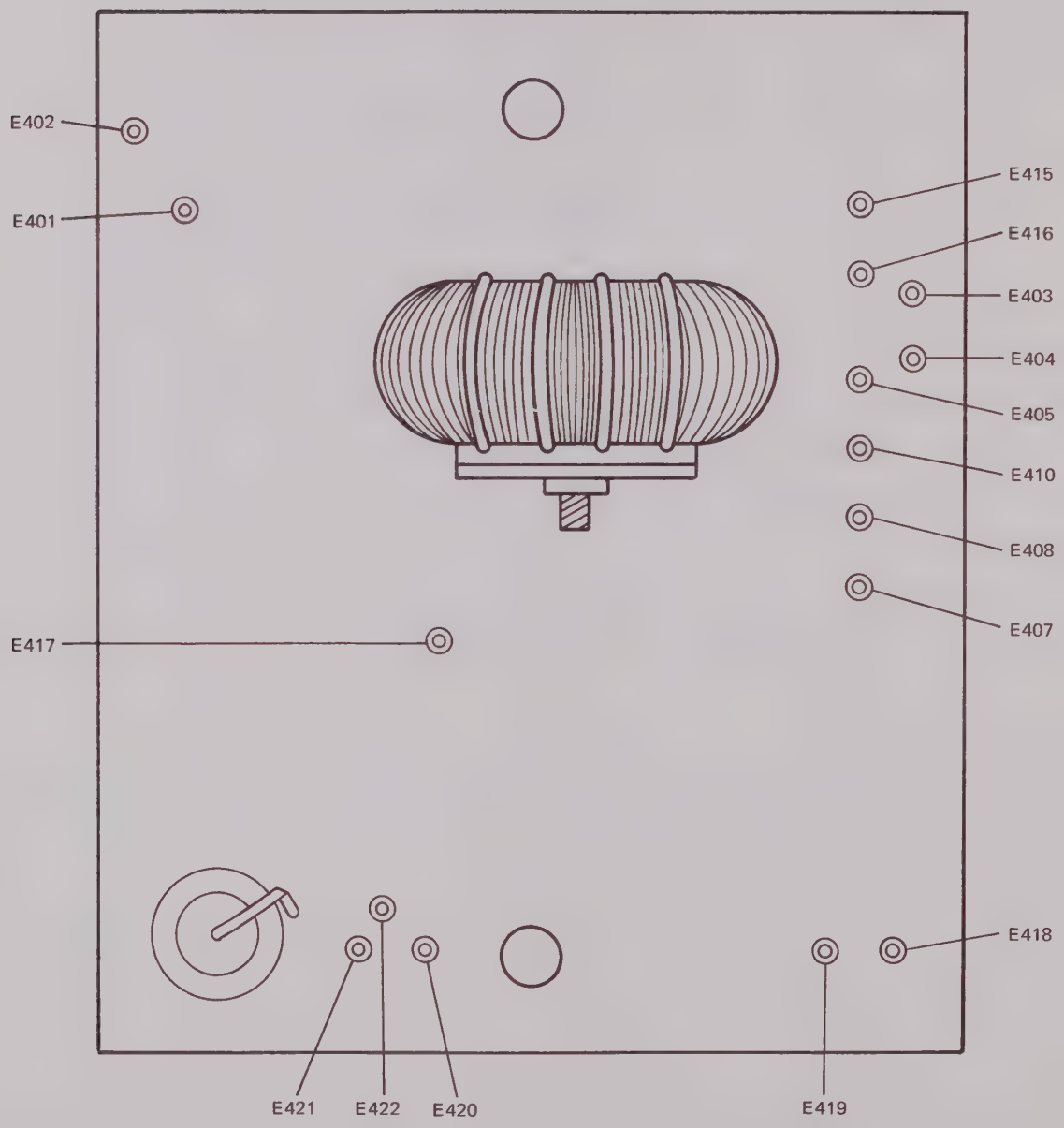


Figure 14-4. Power Supply Board Assembly A2

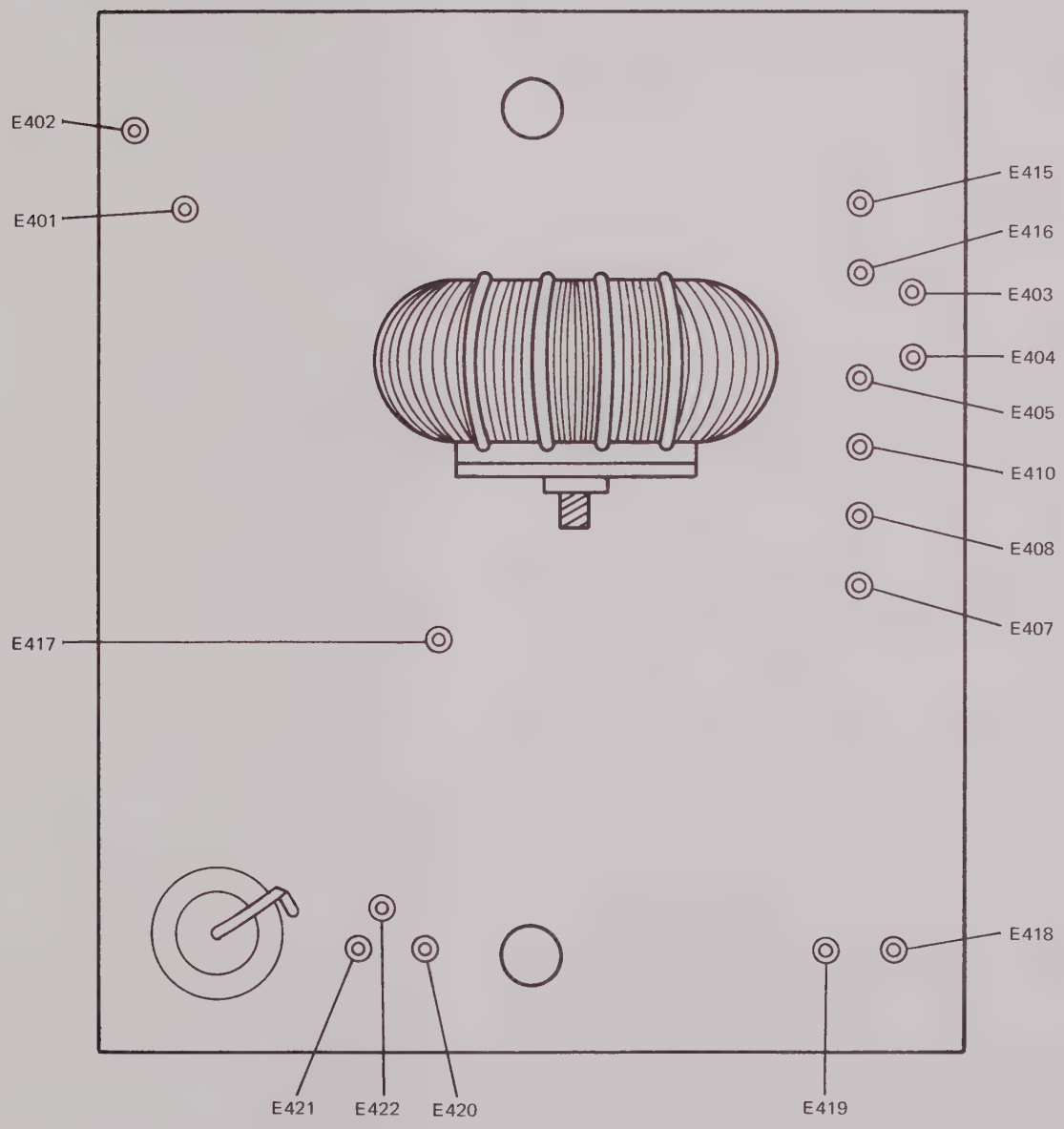
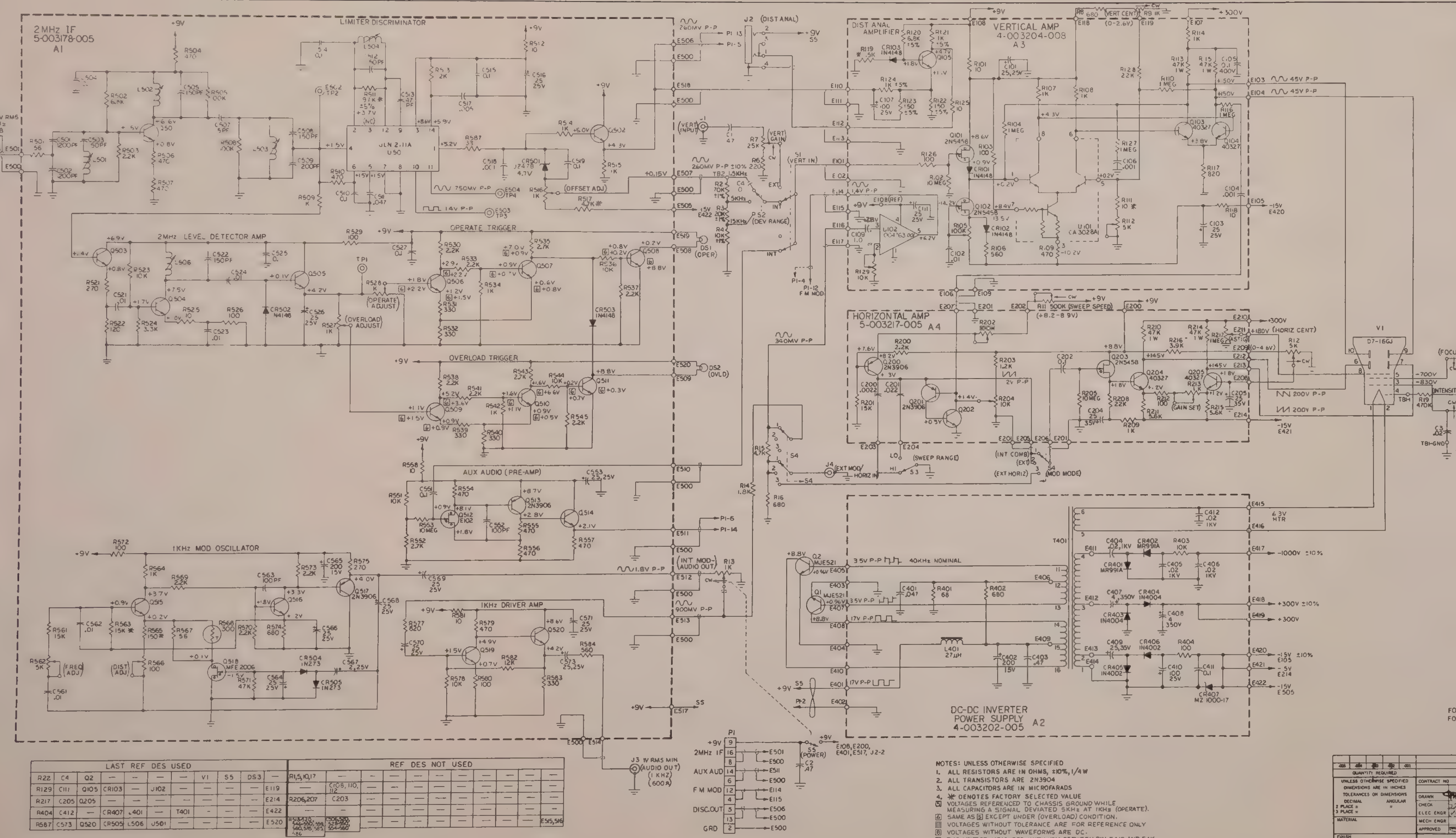


Figure 14-4. Power Supply Board Assembly A2

SECTION XV
ODM-1 SCHEMATIC DIAGRAM



ZONE	LTR	DESCRIPTION	DATE	APPROVED
		RELEASE TO PRODUCTION	3-17-72	
	A	SEE E.O. (PCR 16769)	5-11-72	
	B	SEE E.O (PCR 16958)	6-29-72	E.G.
	C	SEE E.O (PCR 16979)	7-17-72	E.G.
	D	SEE E.O. (PCR17002 & 17009)	7/24/72	E G
	E	SEE E.O. (PCR 17042)	8/1/72	E.G
	F	SEE E.O. (PCR 17048)	8/3/72	E.G.
	G	SEE E.O. (PCR 17144)	8/30/72	E.G.
	H	SEE E.O. (PCR 17182)	9/4/72	E G

LAST REF DES USED											REF DES NOT USED										
R22	C4	Q2	—	—	—	—	V1	S5	DS3	—	R1,5,10,17	—	—	—	—	—	—	—	—	—	—
R129	C111	Q105	CR103	—	J102	—	—	—	—	E119	—	C108, 110, 112	—	—	—	—	—	—	—	—	—
R217	C205	Q205	—	—	—	—	—	—	—	E214	R206,207	C203	—	—	—	—	—	—	—	—	—
R404	C412	—	CR407	L401	—	T401	—	—	—	E422	—	—	—	—	—	—	—	—	—	—	—
R587	C573	Q520	CR505	L506	J501	—	—	—	—	E520	R518-520, 546-550, 558, 560, 576, 585, 586	C506, 520, 528-550, 554-560	—	—	—	—	—	—	—	—	E515,516

NOTES: UNLESS OTHERWISE SPECIFIED
1. ALL RESISTORS ARE IN OHMS, ±10%, 1/4 W
2. ALL TRANSISTORS ARE 2N3904
3. ALL CAPACITORS ARE IN MICROFARADS
4. ✱ DENOTES FACTORY SELECTED VALUE
5. VOLTAGES REFERENCED TO CHASSIS GROUND WHILE MEASURING A SIGNAL DEVIATED 5KHz AT 1KHz (OPERATE).
6. SAME AS 5 EXCEPT UNDER (OVERLOAD) CONDITION.
7. VOLTAGES WITHOUT TOLERANCE ARE FOR REFERENCE ONLY
8. VOLTAGES WITHOUT WAVEFORMS ARE DC.
9. RMS VOLTAGE MEASURED WITH VOM BETWEEN PIN E415 AND E416 CAUTION: THESE PINS ARE AT A HIGH DC POTENTIAL.

FOR S/N'S UP TO 600 USE SCHEMATIC 5-501011-001.
FOR S/N'S 601 & ABOVE USE SCHEMATIC 9-501267-001.

QUANTITY REQUIRED | DESCRIPTION | PART NO. | ITEM
LIST OF MATERIALS

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON DIMENSIONS
DECIMAL 2 PLACE ± 3 PLACE ± ANGULAR ±
MATERIAL
FINISH
MODEL NO ODM-1

CONTRACT NO
DRAWN 3-12-72
CHECK
ELEC ENGR
MECH ENGR
APPROVED

SINGER
ELECTRONIC PRODUCTS DIVISION
METRICH OPERATION LOS ANGELES, CALIF

SCHEMATIC
ODM-1

SIZE | CODE IDENT NO. 88869 | DWG NO. 9-501267-001 | H
SCALE | SHEET OF

Figure 15-1. ODM-1, Schematic Diagram

SECTION XVI
ODM-1 PARTS LIST

ODM-1 MAIN ASSEMBLY

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
A1	IF Board Assy	003178-005	Singer		1
A2	High Voltage Power Supply Board Assy	003202-005	Singer		1
A3	Vertical Amplifier Board Assy	003204-008	Singer		1
A4	Horizontal Amplifier Board Assy	003217-005	Singer		1
C1	Capacitor, Metalized Plastic, ±20%, 250 V dc, 0.47 µF	900001-021	Amperex	C280AE	1
C2	Capacitor, Metalized Plastic, ±20%, 250 V dc, 0.47 µF	900001-021	Amperex	C280AE	1
C3	Capacitor, Ceramic Disc, ±20%, 1000 V dc, 0.02 µF	900012-012	Sprague	5GA-S20	1
DS3	Lamp, Neon	925008-011	G.E.	NE-86	1
P1	Connector	910071-001	Amphenol	26-159-16	1
Q1, Q2	Transistor, Silicon NPN	958001-004	Motorola	MJE521	2
Q3	Not used				0
R5	Not used				0
R6	Resistor, Carbon, 1/4W, ±10%, 220 ohms	945000-029	Allen-Bradley	CB	1
R7/S1	SW/Pot Concentric, 25k, ±20% (VERT GAIN/VERT IN)	003210-001	CTS	Type C212-45	1
R8	Resistor, Carbon, 1/4W, ±10%, 680Ω	945000-035	Allen-Bradley	CB	1
R9/R18	Resistor, Variable Concentric, 1k/1M ±30% (VERT CENTER/ INTENSITY)	003215-002	CTS	Type C2-45	1
R10	Not used				0
R11/S3	SW/Pot Concentric, 500k, ±30% (SWEEP SPEED/SWEEP RANGE)	003210-002	CTS	Type C212-45	1
R12/R21	Resistor, Variable Concentric, 5k/500k, ±30% (HORIZ CENT/FOCUS)	003215-001	CTS	Type C2-45	1
R17	Not used				0

ODM-1 MAIN ASSEMBLY (CONT)

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
R19	Resistor, Carbon, 1/4W, 10%, 470k	945000-069	Allen-Bradley	CB	1
R20	Resistor, Carbon, 1/2W, 5%, 560k	945001-228	Allen-Bradley	EB	1
R22	Resistor, Carbon, 2W, ±10%, 4.7M	945003-081	Allen-Bradley	HB	1
R23 thru R29	Not used				0
CR1	Not used				0
V1	Cathode Ray Tube	917000-001	Telefunken	D7-166J	1

ODM-1 FRONT PANEL ASSEMBLY

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
C4	Capacitor, Metalized Plastic, ±20%, 250V 0.01 μF	900001-001	Amperex	C280AE	1
DS1, DS2	Lamp, Indicator	925007-005	Mura	L10/20	2
J1, 3, 4	Connector, BNC	910043-001	Kings Elect.	KC-19-68	3
J2	Littel Jax	910152-001	Switchcraft Inc.	S-13B	1
R2	Resistor, Film, 1/8W, ±1%, 70k	945016-580	AC1	RN60D	1
R3	Resistor, Film, 1/8W, ±1%, 20k	945016-318	AC1	RN60D	1
R4	Resistor, Film, 1/8W, ±1%, 10k	945016-289	AC1	RN60D	1
R13/S5	Resistor, Variable, ±30%, 1k	402816-001	CTS	Type VF-45	1
R14	Resistor, Carbon, 1/4W, ±10%, 1.8k	945000-040	Allen-Bradley	CB	1
R15	Resistor, Carbon 1/4W, ±10%, 4.7k	945000-045	Allen-Bradley	CB	1
R16	Resistor, Carbon, 1/4W, ±10%, 680Ω	945000-035	Allen-Bradley	Type CB	1
R23	Not used				0
S2	Switch, Rotary	003214-001	CTS	Type 223	1
S4	Switch, Rotary	003214-002	CTS	Type 223	1

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
C501, C502	Capacitor, Mica 5%, 500 V dc, 1200 pF	900003-057	Electro Motive Mfg.	Type DM-15	2
C503	Capacitor, Mica 5%, 500 V dc, 150 pF	900003-034	Electro Motive Mfg.	Type DM-15	1
C504	Capacitor, Met. Pl., 20%, 250 V dc, 0.1 μF	900001-013	Amperex	Type C280AE	1
C505	Capacitor, Mica 5%, 500 V dc, 150 pF	900003-034	Electro Motive Mfg.	Type DM-15	1
C507	Capacitor, Mica, 10%, 500 V dc, 5 pF	900003-004	Electro Motive Mfg.	Type DM-15	1
C508	Capacitor, Mica, 5%, 500 V dc, 150 pF	90003-034	Electro Motive Mfg.	Type DM-15	1
C509	Capacitor, Mica, 500 V dc, 1200 pF	900003-057	Electro Motive Mfg.	Type DM-15	1
C510	Capacitor, Met. Pl. 20%, 250 V dc, 0.1 μF	900001-013	Amperex	Type C280AE	1
C511	Capacitor, Met. Pl., 20%, 250 V dc, 0.047 μF	900001-009	Amperex	Type C280AE	1
C512	Capacitor, Mica, 5%, 500 V dc, 150 pF	900003-034	Electro Motive Mfg.	Type DM-15	1
C513	Capacitor, Mica, 5%, 500 V dc, 47 pF	900003-021	Electro Motive Mfg.	Type DM-15	1
C514, C515	Capacitor, Met. Pl., 20% 250 V dc, 0.1 μF	900001-013	Amperex	Type C280AE	2
C516	Capacitor, Elect., 25 V dc, 25 μF	900039-001	Gen.Instr.Corp.	984-2203	1
C517	Capacitor, Ceramic Disc, 500 V dc, 0.005 μF	900012-004	Erie	801Z5U5-02Z	1
C518	Capacitor, Ceramic Disc, 500 V dc, 0.001 μF	900012-002	Erie	861Z5U-102P	1
C519	Capacitor, Met. Pl., 20%, 250 V dc 0.1 μF	900001-013	Amperex	Type C280AE	1
C520	Not used				0
C521	Capacitor, Met. Pl., 20%, 250 V dc, 0.01 μF	900001-001	Amperex	Type C280AE	1
C522	Capacitor, Mica, 5%, 500 V dc, 150 pF	900003-034	Electro Motive Mfg.	Type DM-15	1
C523, C524	Capacitor, Met. Pl., 20%, 250 V dc, 0.01 μF	900001-001	Amperex	Type C280AE	2
C525	Capacitor, Met. Pl., 20%, 250 V dc, 0.1 μF	900001-013	Amperex	Type C280AE	1
C526	Capacitor, Elect. 25 V dc, 25 μF	900039-001	Gen.Instr. Corp.	984-2203	1
C527	Capacitor, Met. Pl. 20%, 250 V dc, 0.1 μF	900001-013	Amperex	Type C280AE	1

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
C528 thru C550	Not used				0
C551	Capacitor, Met. Pl., 20% 250 V dc, 0.1 μF	900001-013	Amperex	Type C280AE	1
C552	Capacitor, Mica, 5%, 500 V dc, 100 pF	900003-030	Electro Motive Mfg.	Type DM-15	1
C553	Capacitor, Elect, 25 V dc, 25 μF	900039-001	Gen.Instr.Corp	984-2203	1
C554 thru C560	Not used				0
C561, C562	Capacitor, Met. Pl., 20% 250 V dc, 0.01 μF	900001-001	Amperex	Type C280AE	1
C563	Capacitor, Mica, 5%, 500 Vdc, 100 pF	900003-030	Electro Motive Mfg.	Type DM-15	1
C564	Capacitor, Elect., 25 V dc, 25 μF	900039-001	Gen.Instr.Corp	984-2203	1
C565	Capacitor, Elect., 15 V dc, 200 μF	900039-002	Gen.Instr.Corp	984-1733	1
C566	Capacitor, Elect., 25 V dc, 25 μF	900039-001	Gen.Instr.Corp	984-2203	1
C567	Capacitor, Elect., 25 V dc, 2 μF	900023-016	Sprague	TE-1201	1
C568 thru C571	Capacitor, Elect., 25 V dc, 25 μF	900039-001	Gen.Instr.Corp	984-2203	4
C572	Not used				0
C573	Capacitor, Elect., 25 V dc, 25 μF	900039-001	Gen.Inst.Corp	984-2203	1
CR501	Diode, Zener, 4.7 V nom., ±5%	913004-005	Motorola	JZ4.7B	1
CR502, CR503	Diode Silicon	913007-001	G.E.	1N4148	2
CR504, CR505	Diode, Germainium	913005-001	Transitron Elect. Corp.	1N273	2
L501 thru L504	Inductor, Variable, 30 - 60 μH	906006-003	Precision Coil Corp.	L57-2CT-F4	4
L505	Not used				0
L506	Inductor, Variable 30 - 60 μH	906006-003	Precision Coil Corp.	L57-2CT-F4	1
Q501 thru Q511	Transistor, Silicon NPN	958000-001	Motorola	2N3904-5	11
Q512	Transistor, FET N-Channel	958031-003	Siliconics	E 102	1
Q513	Transistor, Silicon PNP	958000-002	Motorola	2N3906-5	1
Q514, Q515, Q516	Transistor, Silicon NPN	958000-001	Motorola	2N3904-5	3
Q517	Transistor, Silicon PNP	958000-002	Motorola	2N3906-5	1
Q518	Transistor, FET N-Channel	958044-003	Motorola, Semiconductor Division	MFE 2006	1

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
Q519, Q520	Transistor, Silicon NPN	958000-001	Motorola	2N3904-5	2
R501	Resistor, Carbon, 1/4W, 10%, 56 ohms	945000-022	Allen-Bradley	Type CB	1
R502	Resistor, Carbon, 1/4W, 10%, 6.8k	945000-047	Allen-Bradley	Type CB	1
R503	Resistor, Carbon, 1/4W, 10%, 2.2k	945000-041	Allen-Bradley	Type CB	1
R504	Resistor, Carbon, 1/4W, 10%, 470 ohms	945000-033	Allen-Bradley	Type CB	1
R505	Resistor, Carbon, 1/4W, 10%, 100k	945000-061	Allen-Bradley	Type CB	1
R506, R507	Resistor, Carbon, 1/4W, 10%, 470 ohms	945000-033	Allen-Bradley	Type CB	2
R508	Resistor, Carbon, 1/4W, 10%, 100k	945000-061	Allen-Bradley	Type CB	1
R509	Resistor, Carbon, 1/4W, 10%, 1k	945000-037	Allen-Bradley	Type CB	1
R510	Resistor, Carbon, 1/4W, 10%, 470 ohms	945000-033	Allen-Bradley	Type CB	1
R511	Resistor, Selected Carbon, 1/4W, 5%, 9.1k nominal	945000-185	Allen-Bradley	Type CB	1
R512	Resistor, Carbon, 1/4W, 10%, 10 ohms	945000-013	Allen-Bradley	Type CB	1
R513	Resistor, Carbon, 1/4W, 10%, 12k	945000-050	Allen-Bradley	Type CB	1
R514, R515	Resistor, Carbon, 1/4W, 10%, 1k	945000-037	Allen-Bradley	Type CB	2
R516	Resistor, Variable, ±30%, 1k	945007-004	CTS	X201	1
R517	Resistor, Selected, Carbon, 1/4W, 10%, 4.7k nominal	945000-045	Allen-Bradley	Type CB	1
R518, R519, T520	Not used				0
R521	Resistor, Carbon, 1/4W, 10%, 270 ohms	945000-030	Allen-Bradley	Type CB	1
R522	Resistor, Carbon, 1/4W, 10%, 120 ohms	945000-026	Allen-Bradley	Type CB	1
R523	Resistor, Carbon, 1/4W, 10%, 10k	945000-049	Allen-Bradley	Type CB	1
R524	Resistor, Carbon, 1/4W, 10%, 3.3k	945000-043	Allen-Bradley	Type CB	1
R525	Resistor, Carbon, 1/4W, 10%, 10 ohms	945000-013	Allen-Bradley	Type CB	1
R526	Resistor, Carbon, 1/4W, 10%, 100 ohms	945000-025	Allen-Bradley	Type CB	1
R527, R528	Resistor, Variable, ±10%, 1k	945056-007	Bourns	3257W1-102	2

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
R529	Resistor, Carbon, 1/4W, 10%, 100 ohms	945000-025	Allen-Bradley	Type CB	1
R530	Resistor, Carbon, 1/4W, 10%, 2.2k	945000-041	Allen-Bradley	Type CB	1
R531, R532	Resistor, Carbon, 1/4W, 10%, 330 ohms	945000-031	Allen-Bradley	Type CB	2
R533	Resistor, Carbon, 1/4W, 10%, 2.2k	945000-041	Allen-Bradley	Type CB	1
R534	Resistor, Carbon, 1/4W, 10%, 1k	945000-037	Allen-Bradley	Type CB	1
R535	Resistor, Carbon, 1/4W, 10%, 2.7k	945000-042	Allen-Bradley	Type CB	1
R536	Resistor, Carbon, 1/4W, 10%, 10k	945000-049	Allen-Bradley	Type CB	1
R537, R538	Resistor, Carbon, 1/4W, 10%, 2.2k	945000-041	Allen-Bradley	Type CB	2
R539, R540	Resistor, Carbon, 1/4W, 10%,330 ohms	945000-031	Allen-Bradley	Type CB	2
R541	Resistor, Carbon, 1/4W, 10%, 2.2k	945000-041	Allen-Bradley	Type CB	1
R542	Resistor, Carbon, 1/4W, 10%, 1k	945000-037	Allen-Bradley	Type CB	1
R543	Resistor, Carbon, 1/4W, 10%, 2.7k	945000-042	Allen-Bradley	Type CB	1
R544	Resistor, Carbon, 1/4W, 10% 10k	945000-049	Allen-Bradley	Type CB	1
R545	Resistor, Carbon, 1/4W, 10% 2.2k	945000-041	Allen-Bradley	Type CB	1
R546 thru R550	Not used				0
R551	Resistor, Carbon, 1/4W, 10%, 10k	945000-049	Allen-Bradley	Type CB	1
R552	Resistor, Carbon, 1/4W, 10%, 2.7k	945000-042	Allen-Bradley	Type CB	1
R553	Resistor, Carbon, 1/4W, 10%, 10M	945000-085	Allen-Bradley	Type CB	1
R554 thru R557	Resistor, Carbon, 1/4W, 10%, 470 ohms	945000-033	Allen-Bradley	Type CB	4
R558	Resistor, Carbon, 1/4W, 10%, 10 ohms	945000-013	Allen-Bradley	Type CB	1
R559, R560	Not used				0
R561	Resistor, Selected	945000-051	Allen-Bradley	Type CB	1
R562	Resistor, Variable, ±30%, 5k	945007-006	CTS	X201	1
R563	Resistor, Selected, Carbon, 1/4W, 10%, 15k nominal	945000-051	Allen-Bradley	Type CB	1
R564	Resistor, Carbon, 1/4W, 10%, 1k	945000-037	Allen-Bradley	Type CB	1
R565	Resistor, Selected, Carbon, 1/4W, 10%, 150 ohms nominal	945000-027	Allen-Bradley	Type CB	1
R566	Resistor, Variable, ±30%, 100 ohms	945007-001	CTS	X201	1
R567	Resistor, Carbon, 1/4W, 10%, 56 ohms	945000-022	Allen-Bradley	Type CB	1

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
R568	Resistor, Thermistor, 300 ohms	945070-001	Corning	Type C20 ±2% Tol.	1
R569, R570	Resistor, Carbon, 1/4W, 15%, 2.2k	945000-041	Allen-Bradley	Type CB	2
R571	Resistor, Carbon, 1/4W, 10%, 47k	945000-057	Allen Bradley	Type CB	1
R572	Resistor, Carbon, 1/4W, 10%, 100 ohms	945000-025	Allen-Bradley	Type CB	1
R573	Resistor, Carbon, 1/4W, 10%, 2.2k	945000-041	Allen-Bradley	Type CB	1
R574	Resistor, Carbon, 1/4W, 10%, 680 ohms	945000-035	Allen-Bradley	Type CB	1
R575	Resistor, Carbon, 1/4W, 10%, 270 ohms	945000-030	Allen-Bradley	Type CB	1
R576	Not used				0
R577	Resistor, Carbon, 1/4W, 10%, 820 ohms	945000-036	Allen-Bradley	Type CB	1
R578	Resistor, Carbon, 1/4W, 10%, 10k	945000-049	Allen-Bradley	Type CB	1
R579	Resistor, Carbon, 1/4W, 10%, 470 ohms	945000-033	Allen-Bradley	Type CB	1
R580	Resistor, Carbon, 1/4W, 10%, 100 ohms	945000-025	Allen-Bradley	Type CB	1
R581	Resistor, Carbon, 1/4W, 15%, 10 ohms	945000-013	Allen-Bradley	Type CB	1
R582	Resistor, Carbon, 1/4W, 10%, 12k	945000-050	Allen-Bradley	Type CB	1
R583	Resistor, Carbon, 1/4W, 10%, 330 ohms	945000-031	Allen-Bradley	Type CB	1
R584	Resistor, Carbon, 1/4W, 10%, 560 ohms	945000-034	Allen-Bradley	Type CB	1
R585, R586	Not used				0
R587	Resistor, Carbon, 1/4W, 10%, 33Ω	945000-019	Allen-Bradley	Type CB	1
U501	Integrated Circuit	926031-001	Sprague	ULN2111A	1

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
C401	Capacitor, Metalized Plastic, ±20%, 250 V, 0.047 μF	900001-009	Amperex	Type C280AE	1
C402	Capacitor, Elect., 15 V, 200 μF	900039-002	Gen. Instr. Corp.	984-1733	1
C403	Capacitor, Metalized Plastic, ±20%, 250 V, 0.47 μF	900001-021	Amperex	Type C280AE	1
C404, C405, C406	Capacitor, Cer. Disc, ±20%, 1000 V, 0.02 μF	900012-012	Sprague	5GA-520	3
C407, C408	Capacitor, Elect., 350 V, 4 μF	900011-001	Cornell Dubilier	Type BR	2
C409	Capacitor, Elect., 35 V, 25 μF	900000-021	Wima	Type Printilyt	1
C410	Capacitor, Elect., 25 V, 100 μF	900039-004	Gen. Instr. Corp.	984-1653	1
C411	Capacitor, Cer. Disc, +80 - 20%, 500 V dc, 0.1 μF	900012-005	Sprague	41C92	1
C412	Capacitor, Cer. Disc. ±20%, 1000 V, 0.02 μF	900012-012	Sprague	5GA-520	1
C401, CR402	Diode, MR991A	913043-002	Motorola	MR991A	2
CR403, CR404	Diode, Silicon	913001-004	Motorola	1N4004	2
CR405, CR406	Diode, Silicon	913001-002	Motorola	1N4002	2
CR407	Diode, Zener	913004-017	Motorola	Type MZ-1000-17	1
L401	Inductor, Filter	003213-001	Singer		1
R401	Resistor, Carbon, 1/4W, 10%, 68 ohms	945000-023	Allen-Bradley	Type CB	1
R402	Resistor, Carbon, 1/4W, 10%, 680 ohms	945000-035	Allen-Bradley	Type CB	1
R403	Resistor, Carbon, 1/4W, 10%, 10k	945000-049	Allen-Bradley	Type CB	1
R404	Resistor, Carbon, 1/4W, 10%, 100 ohms	945000-025	Allen-Bradley	Type CB	1
T401	Transformer	003206-001	Singer		1

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
C100	Not used				0
C101	Capacitor, Elect., 25 V dc, 25 µF	900039-001	Gen. Inst. Corp.	984-2203	1
C102	Capacitor, Metalized Plastic, 20%, 250 V dc, 0.01 µF	900001-001	Amperex	C280AE	1
C103	Capacitor, Elect., 25 V dc, 25 µF	900039-001	Gen. Inst. Corp.	984-2203	1
C104	Capacitor, Ceramic Disc, +100-0%, 500 V dc, 0.001 µF	900012-002	Erie	861Z50102P	1
C105	Capacitor, Dipped Plastic, Non-Inductive, ±10%, 400 V dc, 0.1 µF	900005-115	Mallory	PVC	1
C106	Capacitor, Ceramic Disc, +100-0%, 500 V dc, 0.001 µF	900012-002	Erie	861Z50102P	1
C107	Capacitor, Elect., 25 V dc, 100 µF	900039-004	Gen. Inst. Corp.	984-1653	1
C108	Not used				0
C109	Capacitor, Polarized, 50 V dc, 1.0 µF	900115-003	Dickson Electronics	D1R0GSA50M	1
C110	Not used				0
C111	Capacitor, Elect, 25 V dc, 25 µF	900030-001	Gen. Inst. Corp.	984-2203	1
C112	Not used				0
CR100	Not used				0
CR101, CR102, CR103	Diode, Silicon	913007-001	G.E.	1N4148	3
Q100	Not used				0
Q101, Q102	Transistor, FET N-Channel	958002-002	Motorola	2N5458	2
Q103, Q104	Transistor, Silicon NPN	958004-001	RCA	40327	2
Q105	Transistor, Silicon NPN	958000-001	Motorola	2N3904-5	1
R100	Not used				0
R101	Resistor, Carbon, 1/4W, ±10%, 10 ohms	945000-013	Allen-Bradley	Type CB	1
R102	Resistor, Carbon, 1/4W, ±20%, 10M	945000-085	Allen-Bradley	Type CB	1
R103	Resistor, Carbon, 1/4W, ±10%, 100 ohms	945000-025	Allen-Bradley	Type CB	1
R104	Resistor, Carbon, 1/4W, ±10%, 1M	945000-073	Allen-Bradley	Type CB	1

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
R105	Resistor, Variable, ±30%, 100k	945010-010	CTS	U201	1
R106	Resistor,Carbon, 1/4W, ±10%, 560 ohms	945000-034	Allen-Bradley	Type CB	1
R107	Resistor, Carbon, 1/4W, ±10%, 1k	945000-037	Allen-Bradley	Type CB	1
R108	Resistor, Carbon, 1/4W, ±10%, 1k	945000-037	Allen-Bradley	Type CB	1
R109	Resistor, Carbon, 1/4W, ±10%, 470 ohms	945000-033	Allen-Bradley	Type CB	1
R110	Resistor, Carbon, 1/4W, ±10%, 1M	945000-073	Allen-Bradley	Type CB	1
R111	Resistor, Selected, Carbon, 1/4W, ±10%, 10 ohm nominal	945000-013	Allen-Bradley	Type CB	1
R112	Resistor, Variable, Carbon, ±30%, 5k	945010-006	CTS	U201	1
R113	Resistor, Carbon, 1W, ±10%, 47k	945002-057	Allen-Bradley	Type GB	1
R114	Resistor, Carbon, 1/4W, ±10%, 1k	945000-037	Allen-Bradley	Type CB	1
R115	Resistor, Carbon, 1W, ±10%, 47k	945002-057	Allen-Bradley	Type GB	1
R116	Resistor, Carbon, 1/4W, ±10%, 1M	945000-073	Allen-Bradley	Type CB	1
R117	Resistor, Carbon, 1/4W, ±10%, 820 ohms	945000-036	Allen-Bradley	Type CB	1
R118	Resistor, Carbon, 1/4W, ±10%, 10 ohms	945000-013	Allen-Bradley	Type CB	1
R119	Resistor, Selected, Carbon, 1/4W, 10%, 1.5k nominal	945000-039	Allen-Bradley	Type CB	1
R120	Resistor, Carbon, 1/4W, ±5%, 6.8k	945000-182	Allen-Bradley	Type CB	1
R121	Resistor, Carbon, 1/4W, ±5%, 1k	945000-162	Allen-Bradley	Type CB	1
R122	Resistor, Carbon, 1/4W, ±5%, 150 ohms	945000-142	Allen-Bradley	Type CB	1
R123	Resistor, Carbon, 1/4W, ±5%, 150 ohms	945000-142	Allen-Bradley	Type CB	1
R124	Resistor, Carbon, 1/4W, ±5%, 1k	945000-162	Allen-Bradley	Type CB	1
R125	Resistor, Carbon, 1/4W, ±10%, 10 ohms	945000-013	Allen-Bradley	Type CB	1
R126	Resistor, Carbon, 1/4W, ±10%, 100 ohms	945000-025	Allen-Bradley	Type CB	1
R127	Resistor, Carbon,1/4W, ±10%, 1M	945000-073	Allen-Bradley	Type CB	1
R128	Resistor, Carbon, 1/4W, ±10%, 22k	945000-053	Allen-Bradley	Type CB	1
R129	Resistor, Variable, Carbon, ±30%, 10k	945010-007	CTS	U201	1
U101	Integrated Circuit	926005-001	RCA	CA3028A	1
U102	Amplifier Assembly	004763-001	Singer		1

REF DES	DESCRIPTION	SINGER PART NUMBER	MANUFACTURER	MFR PART NUMBER	QTY
C200	Capacitor, Dipped Plastic, Non-Inductive, ±10%, 400 V dc, .0022 μF	900005-101	Mallory & Co.	Type PVC	1
C201	Capacitor, Dipped Plastic, Non-Inductive, ±10%, 200 V dc, .022 μF	900005-004	Mallory & Co.	Type PVC	1
C202	Capacitor, Metalized Plastic, ±20%, 250 V dc, 0.1 μF	900001-013	Amperex	Type C280AE	1
C203	Not used				0
C204, C205	Capacitor, Electrolytic, 35 V dc, 25 μF	900000-021	Wima	Type Printilyt	2
Q200, Q201	Transistor, Silicon PNP	958000-002	Motorola	2N3906-5	2
Q202	Transistor, Silicon NPN	958000-001	Motorola	2N3905-4	1
Q203	Transistor, FET N-Channel	958002-002	Motorola	2N5458	1
Q204, Q205	Transistor, Silicon NPN	958004-001	RCA	40327	2
R200	Resistor, Carbon, 1/4W, ±10%, 2.2k	945000-041	Allen-Bradley	Type CB	1
R201	Resistor, Carbon, 1/4W, ±10%, 15k	945000-051	Allen-Bradley	Type CB	1
R202	Resistor, Variable, Carbon, ±30%, 100k	945010-010	CTS	U201	1
R203	Resistor, Carbon, 1/4W, ±10%, 1.2k	945000-038	Allen-Bradley	Type CB	1
R204	Resistor, Variable, Carbon, ±30%, 10k	945010-007	CTS	U201	1
R205	Resistor, Carbon, 1/4W, ±10%, 10M	945000-085	Allen-Bradley	Type CB	1
R206, R207	Not used				0
R208	Resistor, Carbon, 1/4W, ±10%, 22k	945000-053	Allen-Bradley	Type CB	1
R209	Resistor, Carbon, 1/4W, ±10%, 1k	945000-037	Allen-Bradley	Type CB	1
R210	Resistor, Carbon, 1W, ±10%, 47k	945002-057	Allen Bradley	Type CB	1
R211	Resistor, Carbon, 1/4W, ±10%, 5.6k	945000-046	Allen Bradley	Type CB	1
R212	Resistor, Carbon, 1/4W, ±10%, 100 ohms	945000-025	Allen-Bradley	Type CB	1
R213	Resistor, Variable, Carbon, ±30%, 1k	945010-004	CTS	U201	1
R214	Resistor, Carbon, 1W, ±10%, 47k	945002-007	Allen-Bradley	Type CB	1
R215	Resistor, Carbon, 1/4W ±15%, 5.6k	945000-046	Allen-Bradley	Type CB	1
R216	Resistor, Carbon, 1/4W, ±10%, 3.9k	945000-044	Allen-Bradley	Type CB	1
R217	Resistor, Variable, Carbon, ±30%, 1M	945010-013	CTS	U201	1

ADDENDUM
For
Manual No. 500783-238
Model No. FM-2748/ODM-1
Effective S/N 801 & Above

Addenda

Perform the following additions to the above manual:

Page 6-1 below A24, Add:

FL1	Filter, 750-760 MHz	403384-001	Singer	1
FL2	Filter, 600-700 MHz	403383-001	Singer	1
FL3	Filter, Lo-pass	003116-002	Singer	1

Page 6-4 below S7, Add:

Z1	Mixer, doubly balanced	403264-001	Singer	1
Z2	Mixer, doubly balanced	403264-001	Singer	1

Errata

Perform the following changes to the above manual:

Page 6-1

Was:

A7-A8	Sub Assembly	003243-001	Singer	2
A9-A10	Sub Assembly	003241-001	Singer	2

Is:

A7	Gain Control Amplifier Assy	003086-001	Singer	1
A8	10 MHz Decade Assy	003085-001	Singer	1
A9	Diode Switch Assy	003087-001	Singer	1
A10	100 MHz Gen Assy	003081-001	Singer	1

REVISED
APPROVED CAB 12-28-72

SINGER INSTRUMENTATION LOS ANGELES, CALIF.	TITLE ADDENDUM MODEL FM2748/ODM-1	DWG NO. I- 500783-238(1) SHEET 1 OF 1

FORM NO. 160 1M 3-70 D-H

ADDENDUM
For
Manual No. 500783-238
Model No. FM-2748/ODM-1
Effective S/N 801 & Above

Addenda

Perform the following additions to the above manual:

Page 6-1 below A24, Add:

FL1	Filter, 750-760 MHz	403384-001	Singer	1
FL2	Filter, 600-700 MHz	403383-001	Singer	1
FL3	Filter, Lo-pass	003116-002	Singer	1

Page 6-4 below S7, Add:

Z1	Mixer, doubly balanced	403264-001	Singer	1
Z2	Mixer, doubly balanced	403264-001	Singer	1

Errata

Perform the following changes to the above manual:

Page 6-1

Was:

A7-A8	Sub Assembly	003243-001	Singer	2
A9-A10	Sub Assembly	003241-001	Singer	2

Is:

A7	Gain Control Amplifier Assy	003086-001	Singer	1
A8	10 MHz Decade Assy	003085-001	Singer	1
A9	Diode Switch Assy	003087-001	Singer	1
A10	100 MHz Gen Assy	003081-001	Singer	1

DESIGNED
INSTRUMENTATION
TITLE
ADDENDUM
MODEL FM2748/ODM-1
DWG NO.
500783-238(1)
SHEET 1 OF 1